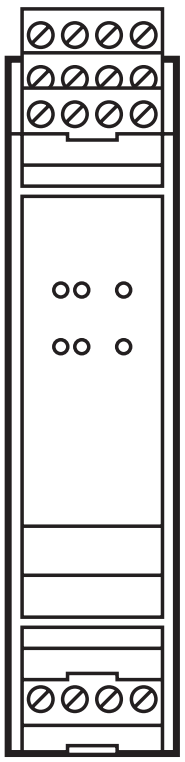
ifm electronic

CE

Original operating instructions
Safety relay with
semiconductor outputs
efector110

G1503S

UK



704598 / 01 04 / 2012

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1 Preliminary note

The instructions are part of the unit. They are intended for authorised persons according to the EMC and Low Voltage Directive and safety regulations.
The instructions contain information about the correct handling of the product.
Read the instructions before use to familiarise yourself with operating conditions, installation and operation.
Adhere to the safety instructions.

1.1 Symbols used

- ▶ Instructions
- > Reaction, result
- → Cross-reference
- ○ LED off
- ● LED on
- ✱ LED flashes
- ✺ LED flashes quickly

Important note
Non-compliance can result in malfunction or interference.

Information
Supplementary note.

2 Safety instructions

- Follow the operating instructions.
- Improper use may result in malfunctions of the unit. This can lead to personal injury and/or damage to property during operation of the machine. For this reason note all remarks on installation and handling given in these instructions. Also adhere to the safety instructions for the operation of the whole installation.
- In case of non-observance of notes or standards, specially when tampering with and/or modifying the unit, any liability and warranty is excluded.
- The unit must be installed, connected and put into operation by a qualified electrician trained in safety technology.
- The applicable technical standards for the corresponding application must be complied with.
- For installation the requirements according to EN 60204 must be observed.
- In case of malfunction of the unit please contact the manufacturer. Tampering with the unit is not allowed.
- Disconnect the unit externally before handling it. Also disconnect any independently supplied relay load circuits.
- After setup the system has to be subjected to a complete function check.
- Only use the unit under the specified operating conditions (→ 10 Technical data). In case of special operating conditions please contact the manufacturer.
- Use only as described below (→ 4).

3 Items supplied

- 1 safety relay G1503S
- 1 operating instructions safety relay, reference 704598.

If one of the above-mentioned components is missing or damaged, please contact one of the ifm branch offices.

4 Functions and features

The safety relay is a redundant system and suited for use as:

- Safety relay for fail-safe sensors/switches with 2 PNP outputs (e.g. GM701S, → chapter 8.1).
- Safety relay for clocked fail-safe sensors (e.g. GM504S, → chapter 8.2).
- Two-hand control to EN 574, type IIIC, with electronic sensors/switches (→ chapter 8.3).
- Two-hand control to EN 574, type IIIC with mechanical switches / safety relay for mechanical switches or 2-channel fail-safe sensors/switches (e.g. ESPE to EN 61496-1) with contact output with simultaneity monitoring (→ chapter 8.4).
- Safety relay for e-stop, for two-channel fail-safe sensors/switches (e.g. ESPE to EN 61496-1) with contact output without simultaneity monitoring (indefinite simultaneity) or for mechanical switches (→ chapter 8.5).

ifm electronic gmbh assumes no liability for the use of units made by external manufacturers.

The safe state is when the output is switched off (zero-current state: logic "0") of at least one of the semiconductor outputs 13 or 14 (C1).

4.1 Requirements for the hardware configuration

The following requirements must be complied with when using the safety relay G1503S:

4.1.1 Product-independent requirements

It must be ensured that the safety requirements of the respective application correspond to the requirements stated in these instructions.

The specified technical data indicated in these instructions must be complied with. The principle of normally closed operation must be applied to all external safety circuits connected to the system.

The safety relays type G1503S in operation have to be subjected to a self-test (switching off) within a period of maximum 12 months.

The self-test can be carried out by switching the supply voltage off and on or by a safety request.

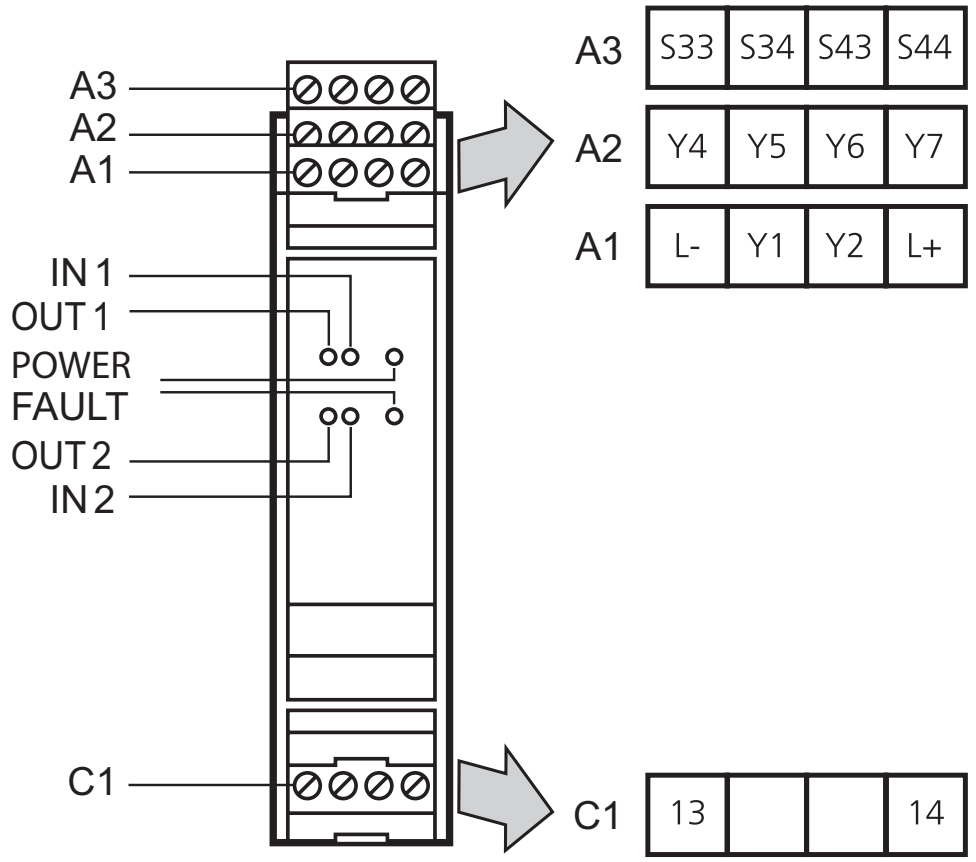
4.1.2 Product-dependent requirements

In case of faults within the safety relay which result in the defined safe state, the safety relay must be replaced.

Any faulty unit should be returned to the manufacturer.

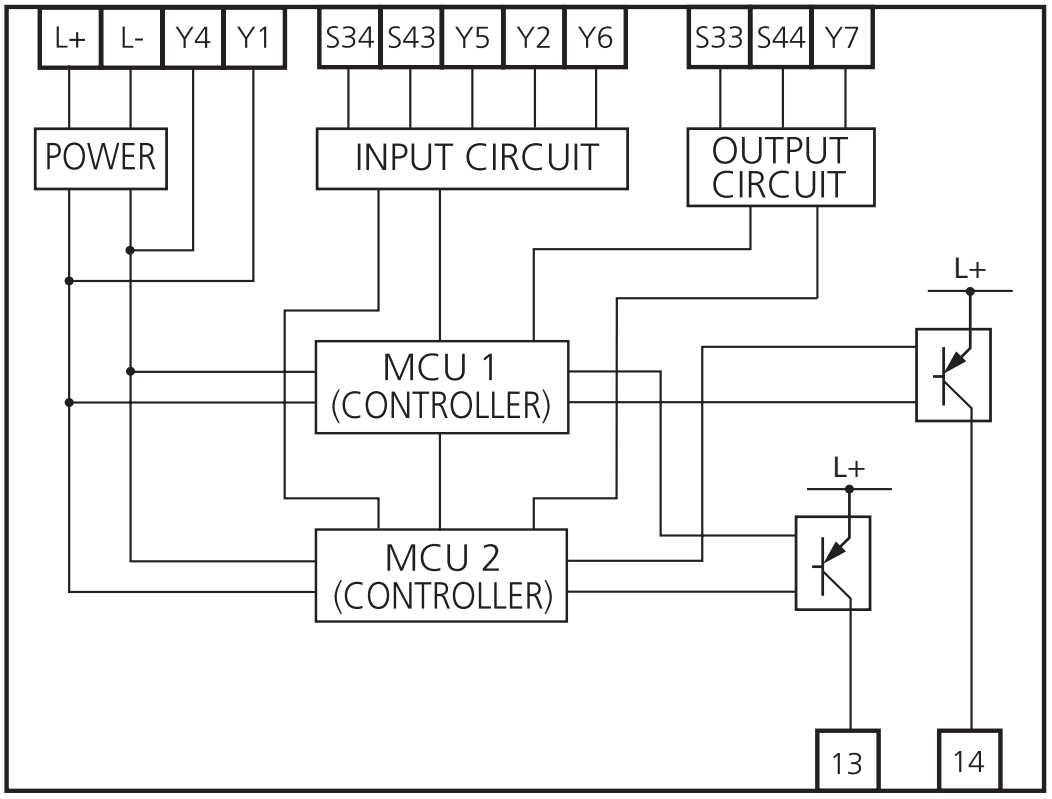
5 Structure and operating principle

5.1 Indicators and connections



A1	Supply voltage (L-, L+), function terminals (Y1, Y2)
A2	Y4, Y5, Y6, Y7: Operating mode selection, auxiliary output
A3	S33, S34, S43, S44: Connection for safety inputs / outputs
OUT 1	LED yellow: Triggering of the semiconductor output channel 1
OUT 2	LED yellow: Triggering of the semiconductor output channel 2
IN 1	LED yellow: Input signal channel 1 or TE (for clocked sensor)
IN 2	LED yellow: Input signal channel 2 or A (for clocked sensor)
Power	LED green: Voltage supply
Fault	LED red: Fault/start-up
C1	13,14: Connection of one safe PNP output

5.2 Block diagram



6 Installation

▶ Mount the unit on a DIN rail in a housing protected against dust and humidity (min. IP54 - degree of soiling 2).

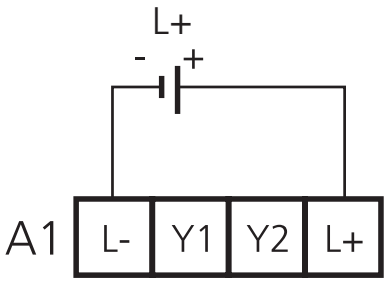
Use 60/75°C copper conductors only.

7 Electrical connection

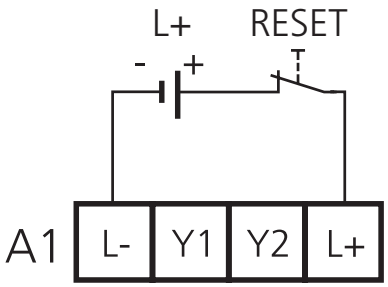
7.1 Supply voltage

The external supply unit must have a safe separation. In case of a fault the voltage can exceed the value of 60 V DC for a maximum of 200 ms, but must not exceed the value of 120 V DC.

▶ **Connect supply voltage**



Manual reset

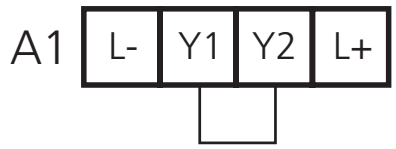


For safety reasons the unit can only be restarted by separation from the supply voltage in case of a fault. It is thus recommended to install a RESET switch in series with the L+ circuit.

After power on or a RESET the unit carries out self diagnostic functions. After this self diagnosis the unit is ready for operation.

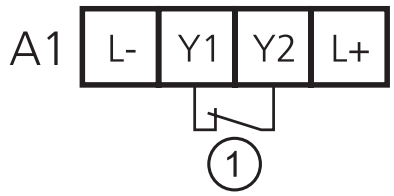
7.2 Feedback contacts / monitored or automatic start

Automatic start



Automatic activation without monitoring.

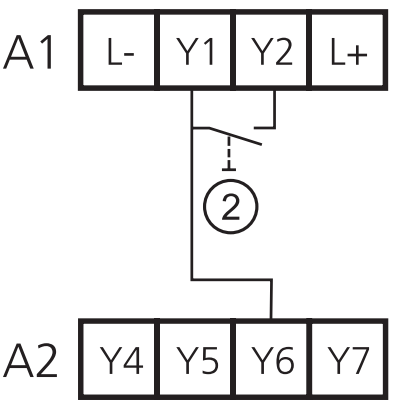
Monitoring of the feedback contacts (normally closed) for automatic start



Release is made when the feedback contacts are closed.
Consider the current flowing through the feedback contacts (→ 10 Technical data).

1: Feedback contact

Monitored start

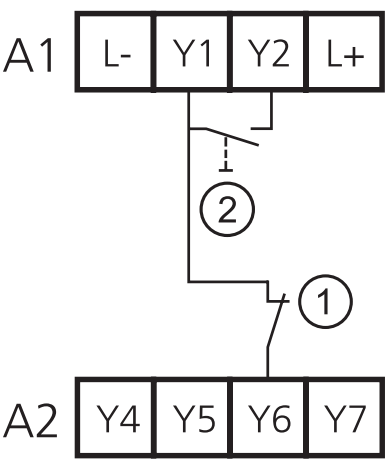


Release of the solid state outputs:
▶ Press and release the start button (> 50 ms).

This function is not active when used as two-hand control.

2: Start button

Monitoring of the feedback contacts (normally closed) for monitored start



Release of the solid state outputs:
The feedback contacts are closed
▶ Press and release the start button (> 50 ms).

This function is not active when used as two-hand control.

Consider the current flowing through the feedback contacts (→ 10 Technical data).

1: Feedback contact
2: Start button

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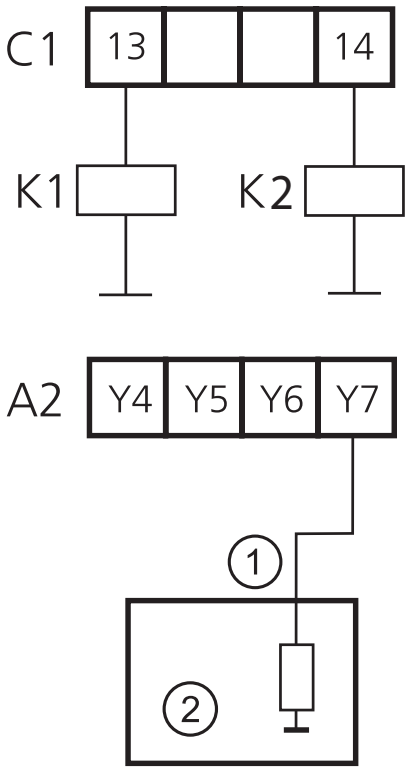
7.3 Output circuit

Connect the load



▶ Connect the load to be controlled to the semiconductor outputs C1 (13-14).

Adhere to the maximum and minimum load conditions (→ 10 Technical data).

Output Y7 provides a non-safety related signal for communication to a PLC. The signal corresponds to the logical levels of the safe semiconductor outputs 13, 14. The output data is compatible with the input data of the current-sinking inputs of type 1, 2, 3 to EN 61131-2.

1: Input
2: PLC

8 Connection - Function - Fault diagnosis

The safety relay can be connected or used in different ways:

1. Safety relay for fail-safe sensors/switches with 2 PNP outputs (e.g.GM701S).
2. Safety relay for clocked fail-safe sensors (e.g. GM504S).
3. Two-hand control to EN 574, type IIIC with electronic sensors.
4. Two-hand control to EN 574, type IIIC with mechanical switches / safety relay for mechanical switches or 2-channel fail-safe sensors/switches (e.g. ESPE to EN 61496-1) with contact output with simultaneity monitoring.
5. Safety relay for e-stop, for two-channel fail-safe sensors/switches (e.g. ESPE to EN 61496-1) with contact output without simultaneity monitoring (indefinite simultaneity) or for mechanical switches.

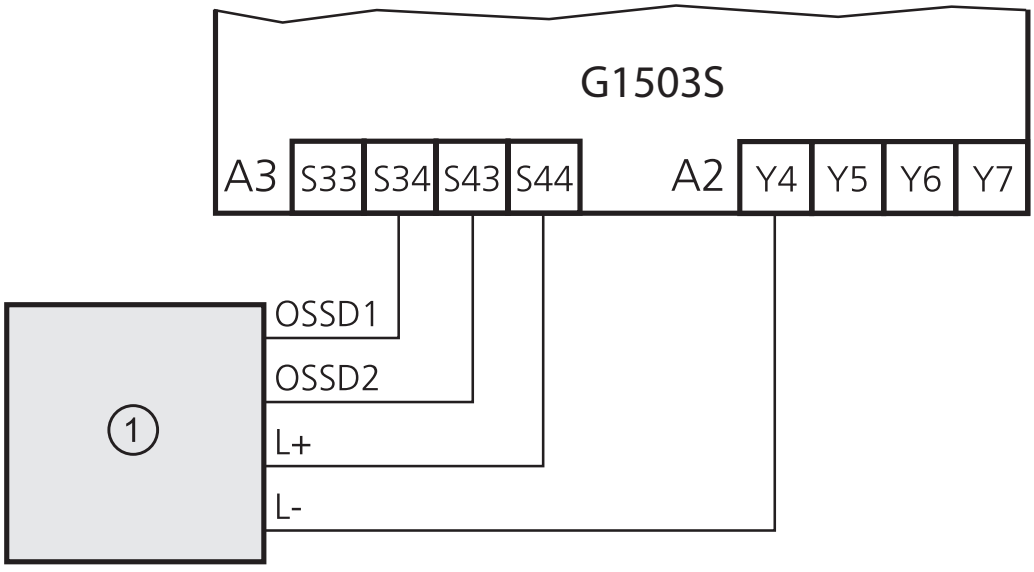
8.1 Safety relay for fail-safe sensors/switches with 2 PNP outputs

Example of fail-safe sensors/switches:

- Fail-safe inductive sensor GM701S
- Light barrier
- Light curtain (ESPE to EN 61496-1)
- Laser scanner

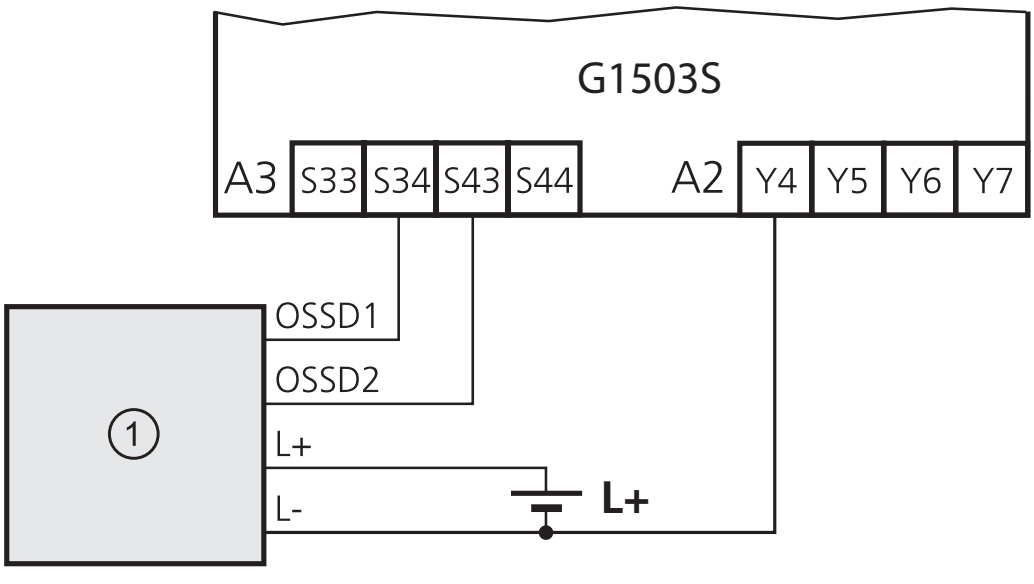
8.1.1 Connection

Fail-safe sensor/switch with a current consumption of ≤ 50 mA:



1: Fail-safe sensor/switch

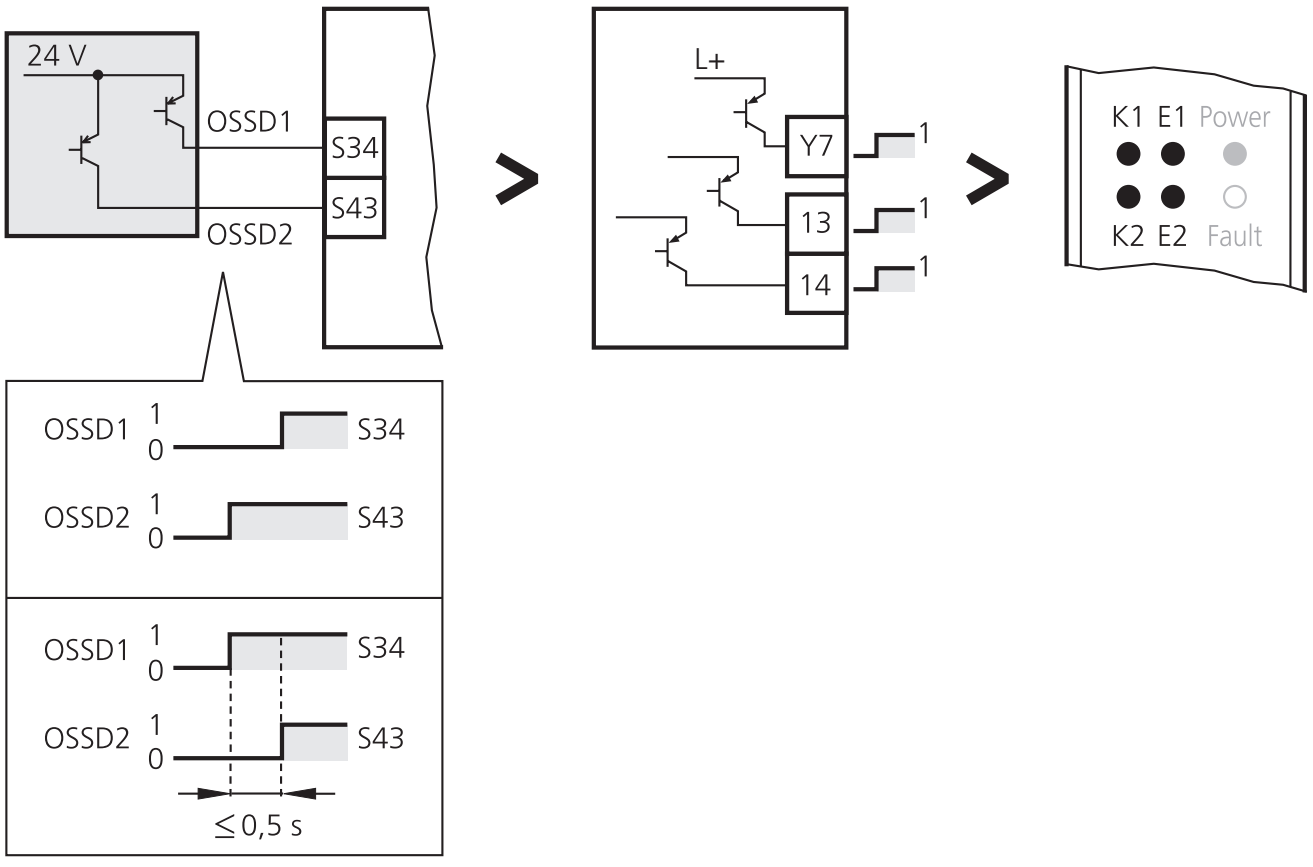
Fail-safe sensor/switch with a current consumption of > 50 mA:

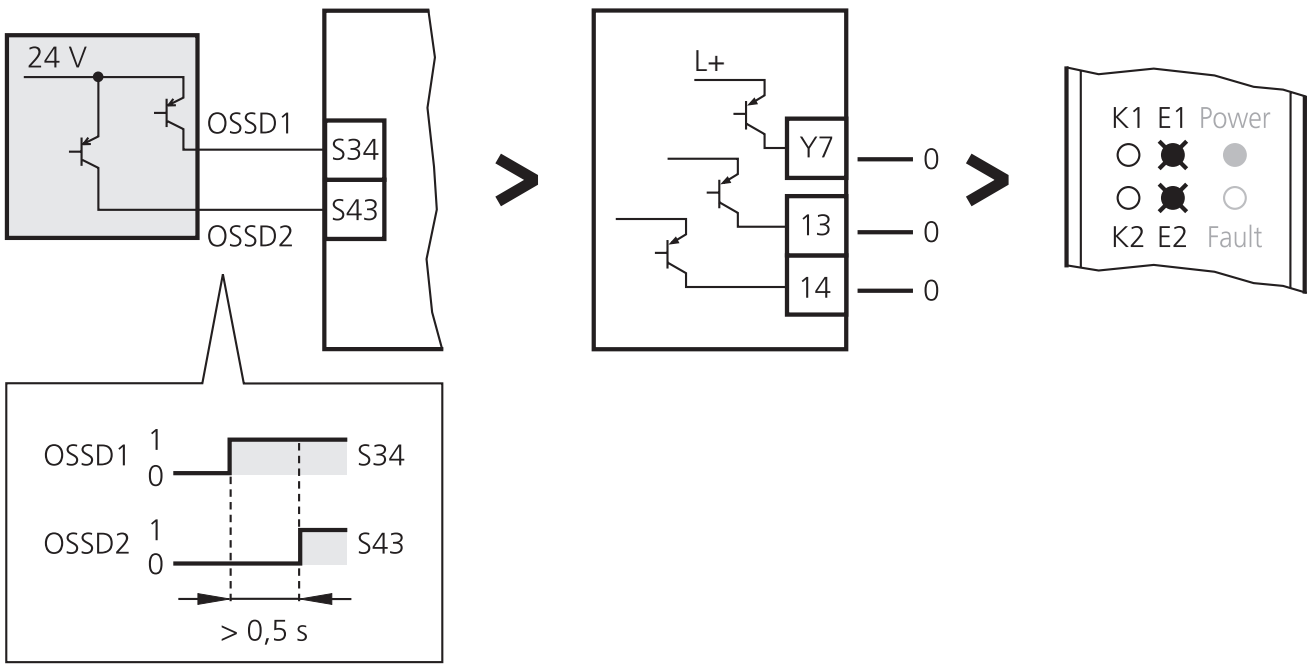


1: Fail-safe sensor/switch

8.1.2 Function

Input circuit	Output status	LED display





Stop flashing:

▶ Activate inputs in correct time sequence (→ fig. above)

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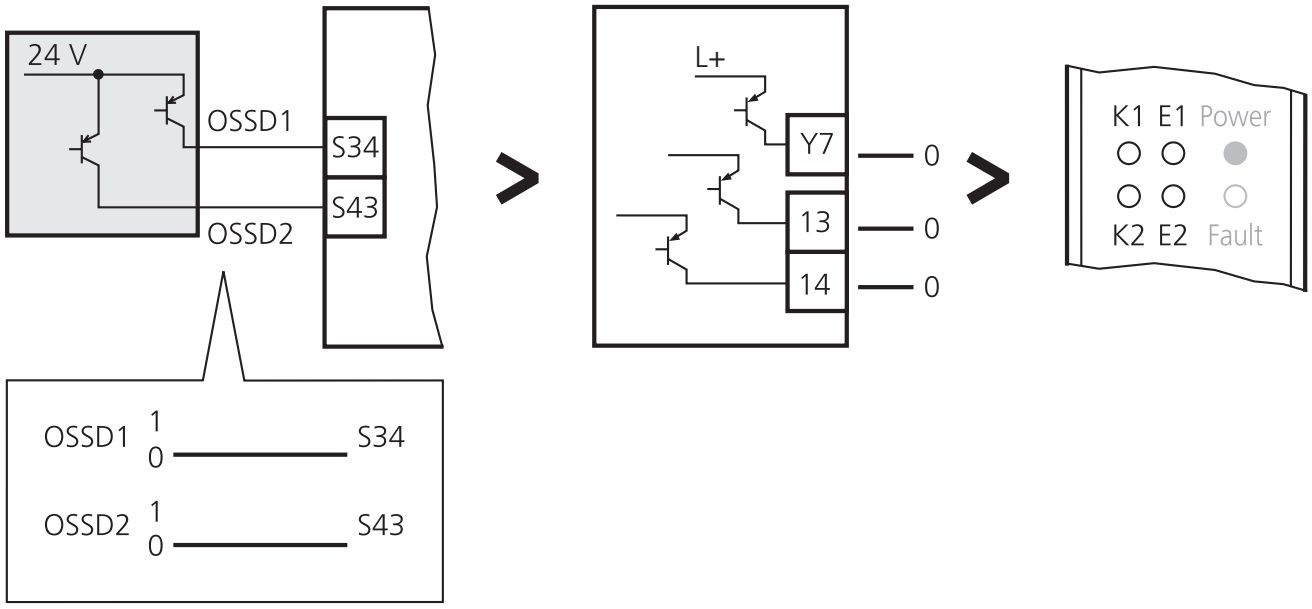
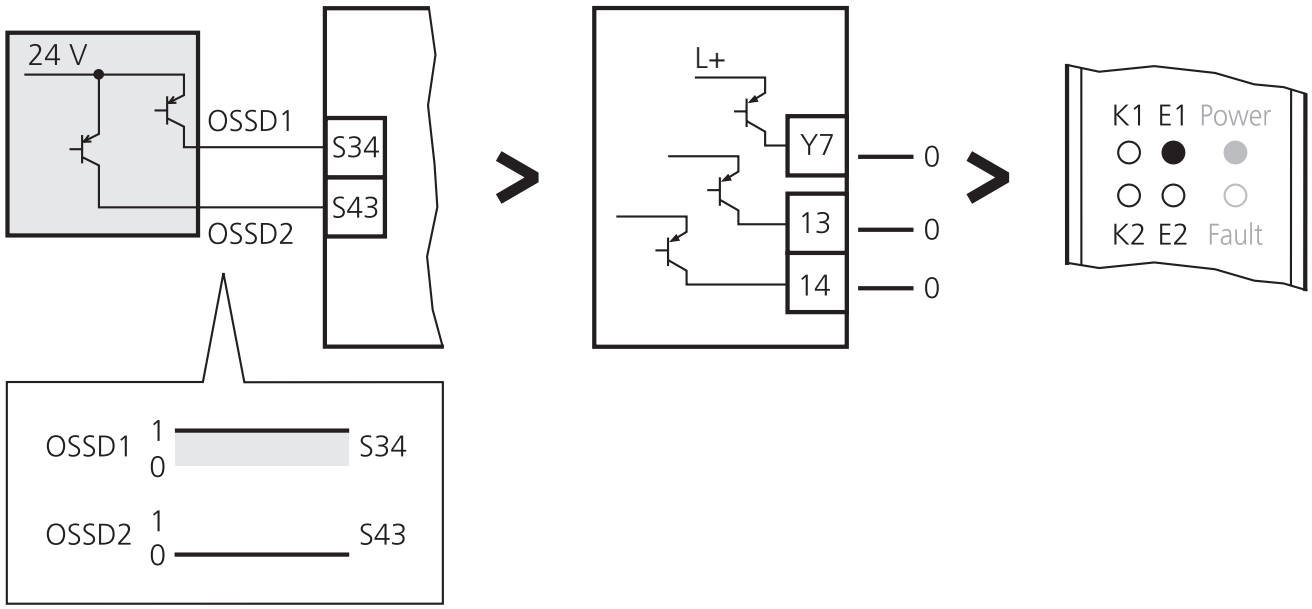
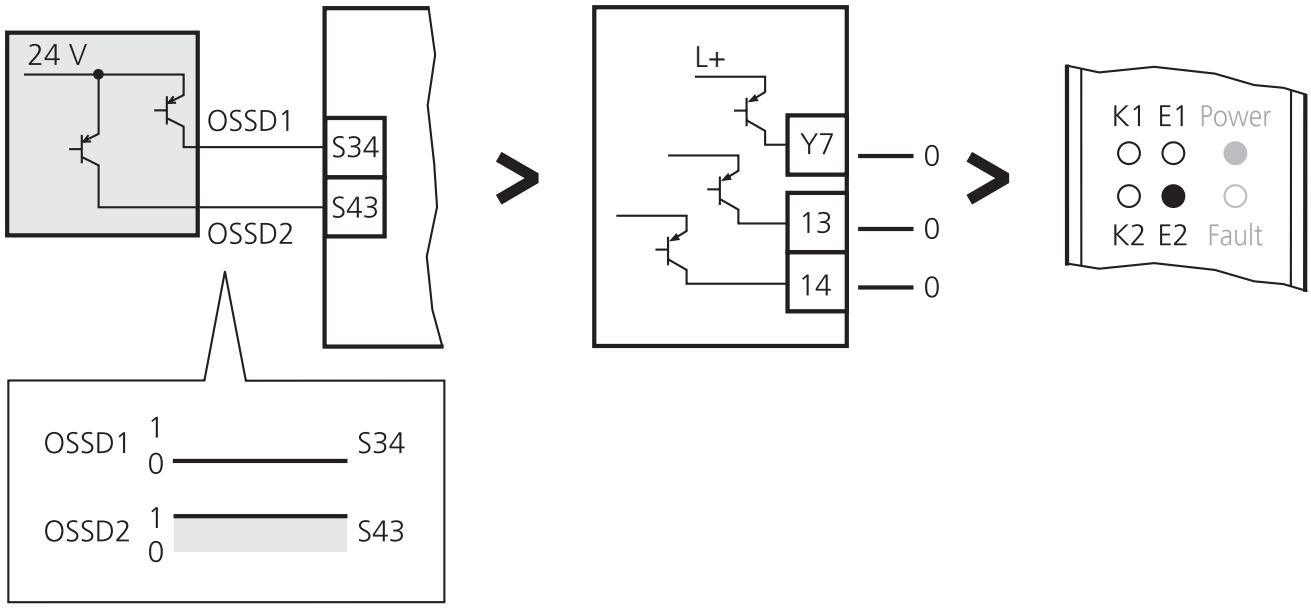
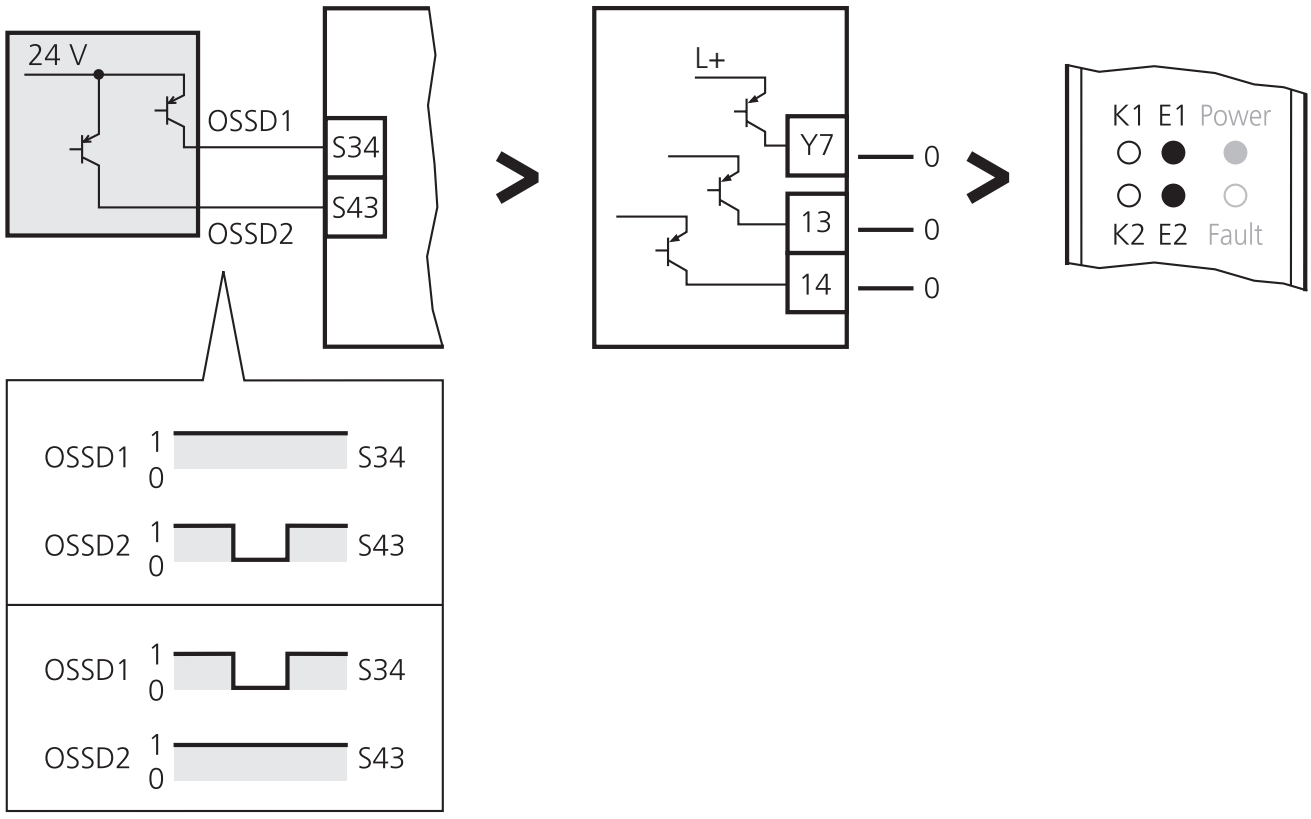
Input circuit	Output status	LED display





Input circuit	Output status	LED display





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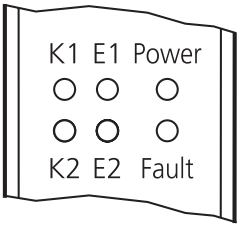
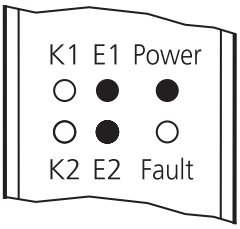
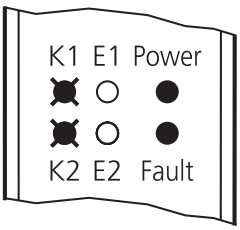
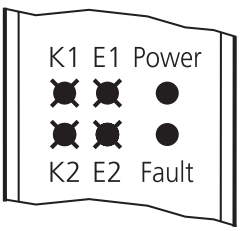
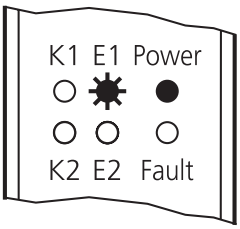
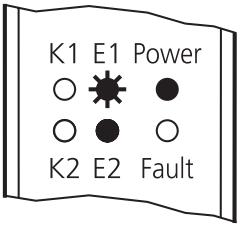
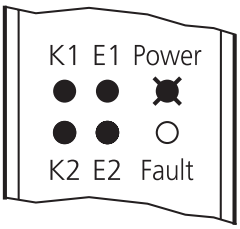
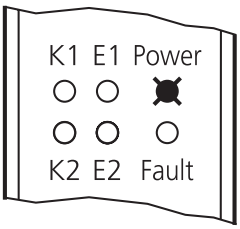
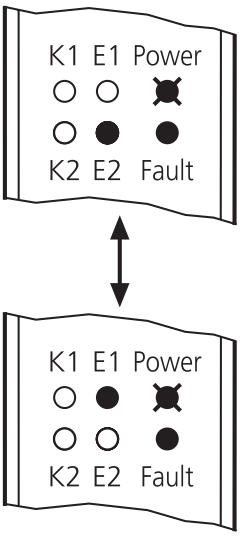
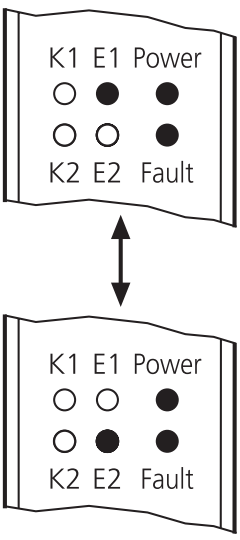
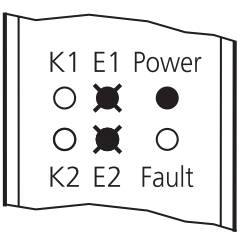
8.1.3 Fault diagnosis

In case of a fault switch the safety relay off and on again.

LED display	Cause of the fault	Troubleshooting
	• No voltage supply • Overvoltage • Connection A1/A3 or A1/A2 reversed	▶ Check wiring ▶ Check power supply
	• Wire break • Feedback contacts open	▶ Check wiring ▶ Switch the safety relay off and on again
	• When voltage is applied: feedback contacts open	▶ Check output circuit ▶ Check feedback contacts ▶ Exchange external contactor
	• Wiring fault • Short circuit • Inputs S34 and S43 “1” when voltage is applied	▶ Check wiring ▶ Switch the fail-safe sensor/ switch off and on again
	• Short circuit S33/S43	▶ Check wiring
	• Short circuit S33/S43	▶ Check wiring

LED display	Cause of the fault	Troubleshooting
	• Overvoltage • Undervoltage	▶ Check wiring ▶ Check power supply
	• Overvoltage • Undervoltage	▶ Check wiring ▶ Check power supply
	• Undervoltage	▶ Check wiring ▶ Check power supply
	• Short circuits	▶ Check wiring
	• Input S43 active more than 0.5 s after input S34 (→ 8.1.2) • Feedback contact error • Short circuit S34/S44	▶ Check wiring ▶ Switch the fail-safe sensor/ switch off and on again

8.2 Safety relay for clocked fail-safe sensors

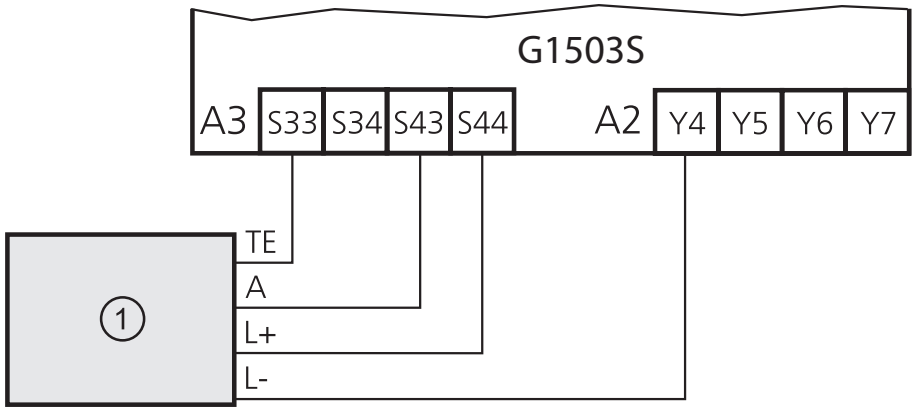
Example of fail-safe sensors/switches:

- Fail-safe inductive sensor GM504S

Up to 10 clocked fail-safe sensors can be connected to one safety relay.

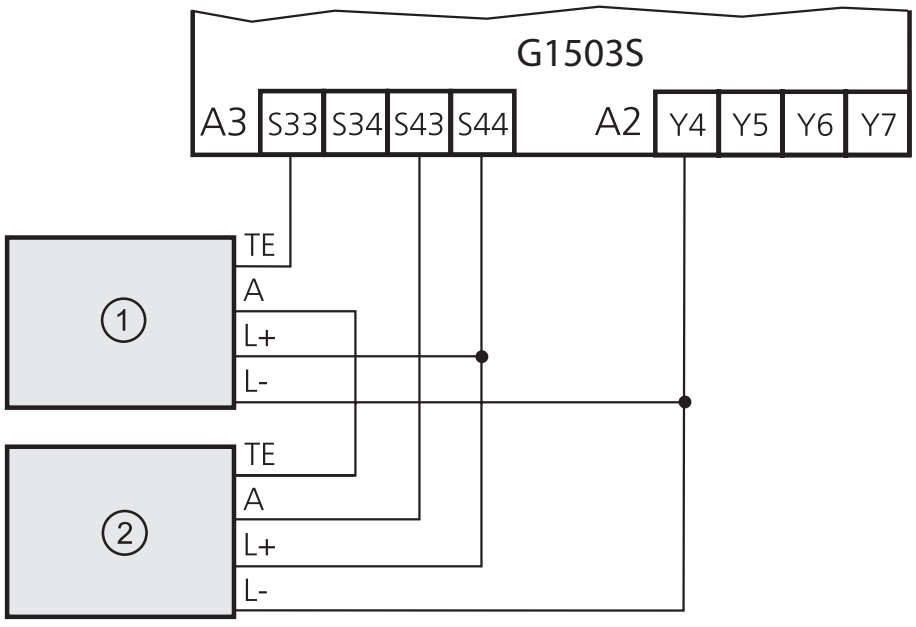
8.2.1 Connection

Connection of one fail-safe sensor/switch:



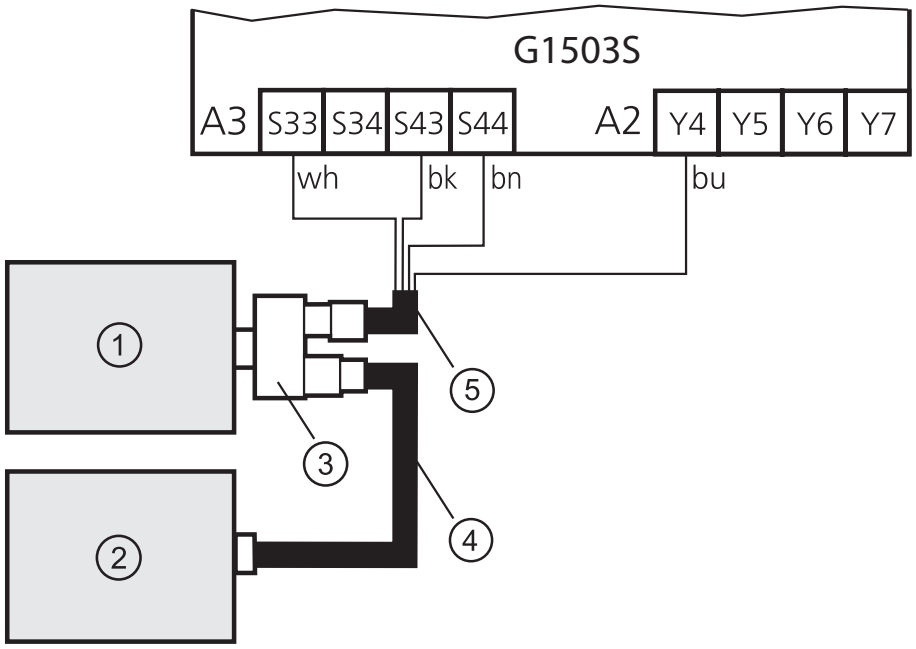
1: Fail-safe sensor/switch

Connection of 2 fail-safe sensors/switches:



1: Fail-safe sensor/switch 1 2: Fail-safe sensor/switch 2

The use of the safety splitter box E11569 is recommended:



1: Fail-safe sensor/switch 1
2: Fail-safe sensor/switch 2
3: E11569
4: e.g. EVC014
5: e.g. EVT001

wh = white
bk = black
bn = brown
bu = blue

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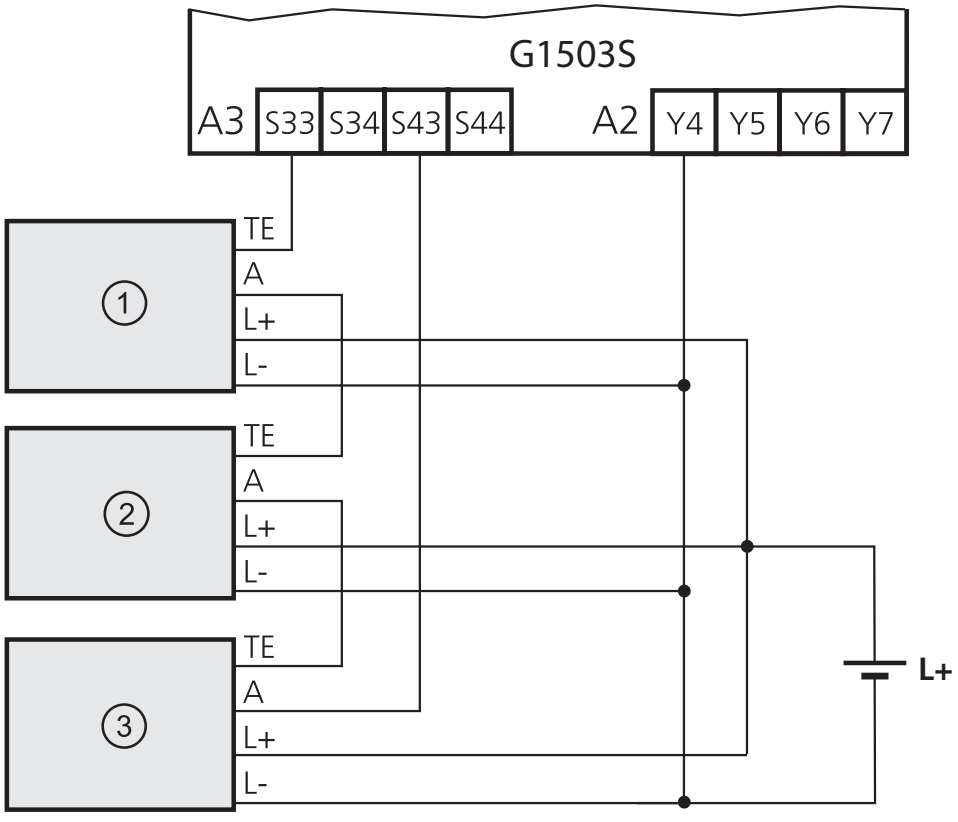
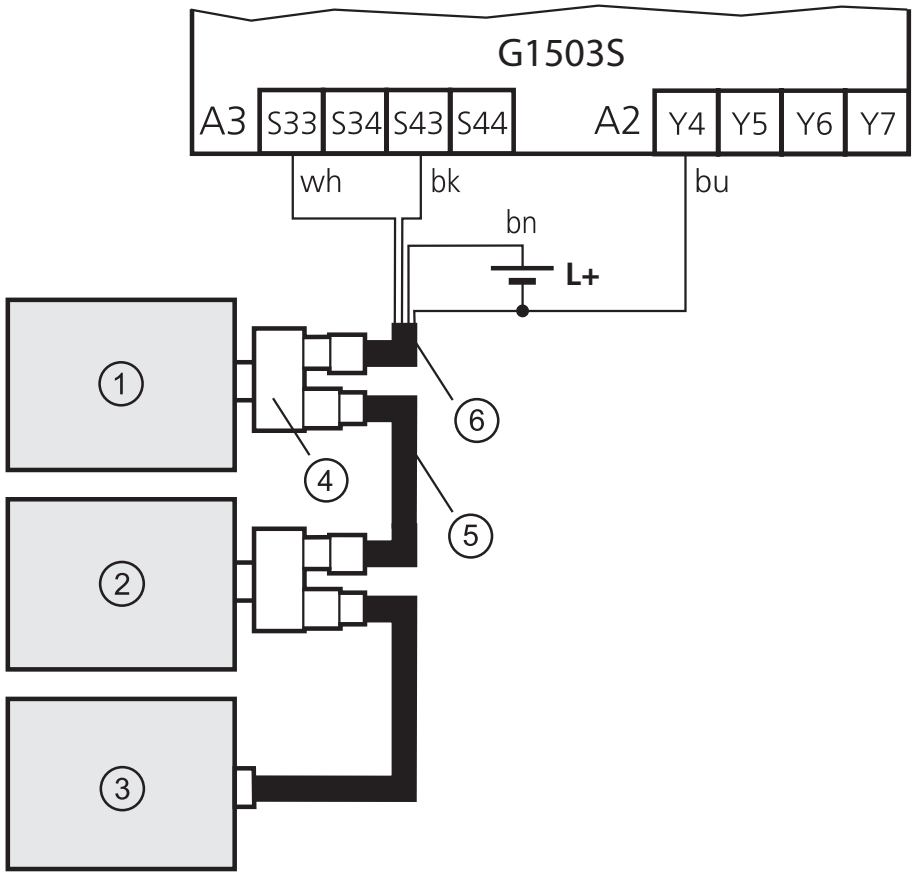
Connection of 3 to 10 fail-safe sensors/switches:



1: Fail-safe sensor/switch 1
2: Fail-safe sensor/switch 2
3: Fail-safe sensor/switch 3

The use of the safety splitter box E11569 is recommended:

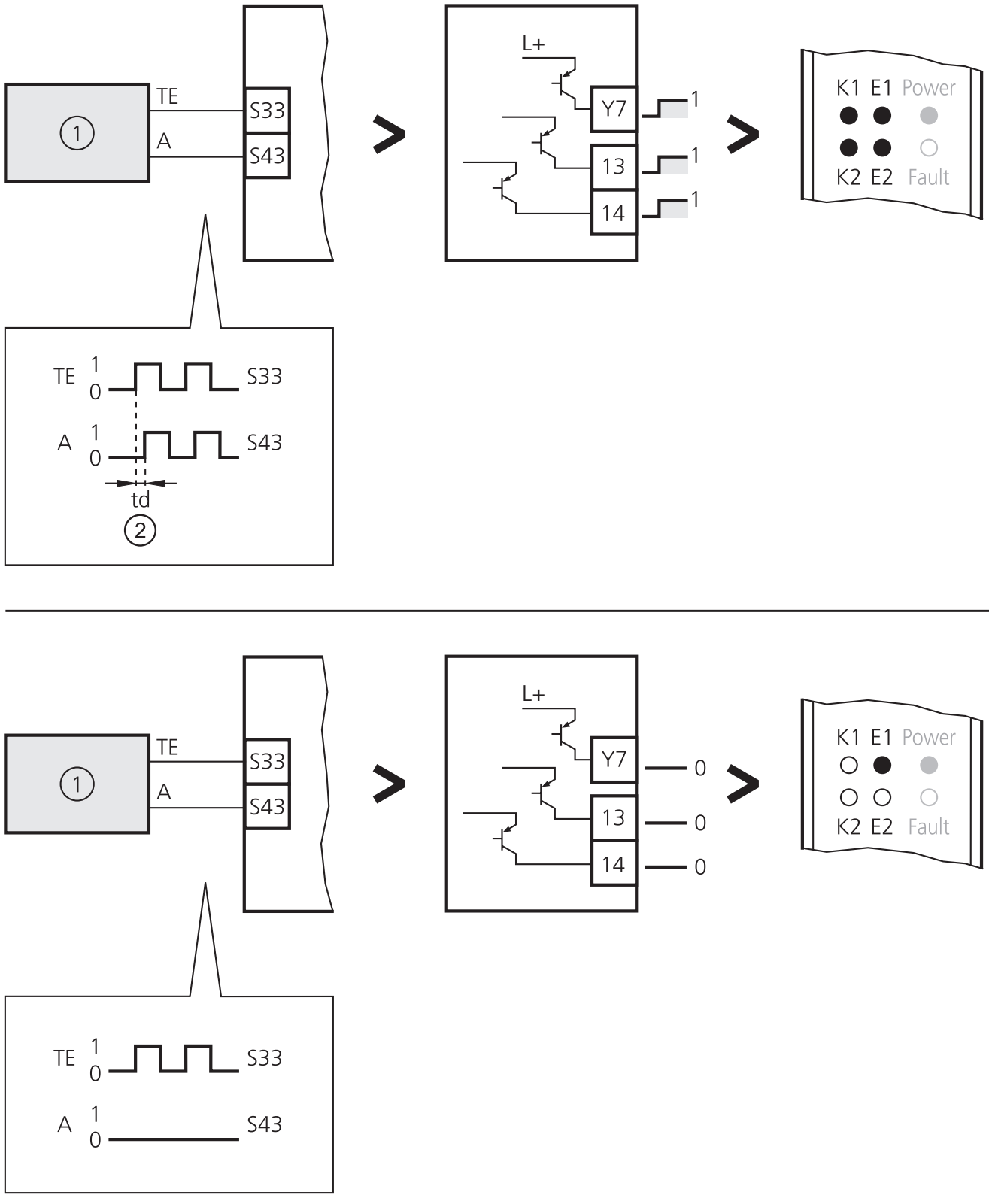


1: Fail-safe sensor/switch 1
2: Fail-safe sensor/switch 2
3: Fail-safe sensor/switch 3

4: E11569
5: e.g. EVC014
6: e.g. EVT001

wh = white
bk = black
bn = brown
bu = blue

8.2.2 Function

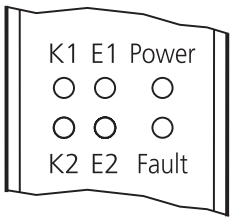
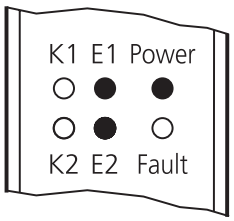
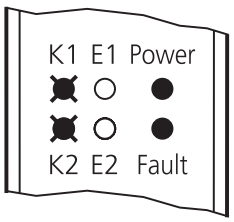
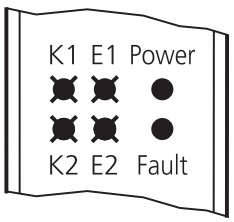
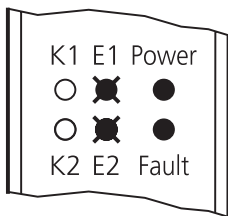
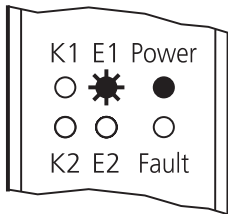
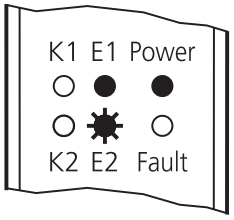


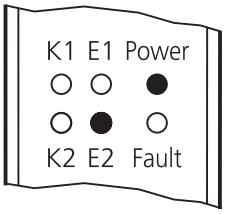
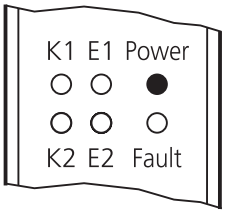
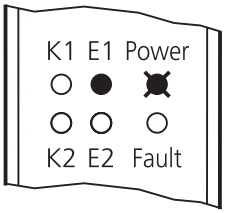
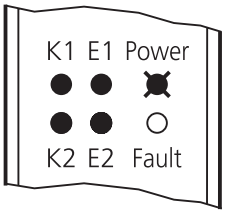
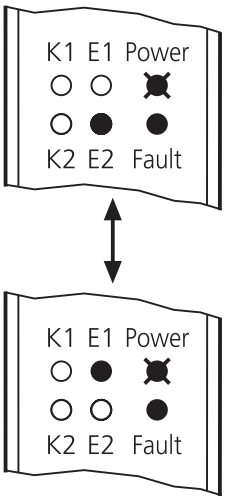
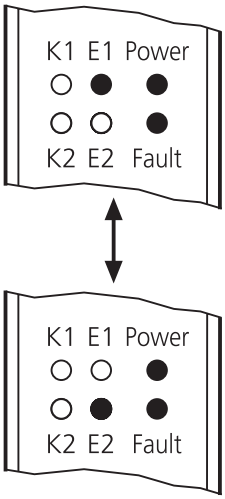
1: First or last fail-safe sensor/switch of a row of sensors/switches
2: td = max. 16 ms

UK

8.2.3 Fault diagnosis

In case of a fault switch the safety relay off and on again.

LED display	Cause of the fault	Troubleshooting
	• No voltage supply • Overvoltage • Connection A1/A2 reversed	▶ Check wiring ▶ Check power supply
	• Wire break • Feedback contacts open • Time-dependent contacts	▶ Check wiring ▶ Switch the safety relay off and on again
	• When voltage is applied: feedback contacts open	▶ Check output circuit ▶ Check feedback contacts ▶ Exchange external contactor
	• Short circuit • Connection A1/A3 or A2/A3 exchanged	▶ Check wiring
	• Short circuit S43/L+ or S44/L-	▶ Check wiring
	• Short-circuit S34/S44 or S33/S43	▶ Check wiring
	• Short circuit S34/L+	▶ Check wiring

LED display	Cause of the fault	Troubleshooting
	• Short circuit S43/L+ or S34/S44	▶ Check wiring
	• Missing clock • Wiring fault • Connection A2/A3 exchanged • Short circuit S43/L-	▶ Check wiring
	• Overvoltage • Undervoltage	▶ Check wiring ▶ Check power supply
	• Overvoltage • Undervoltage	▶ Check wiring ▶ Check power supply
	• Undervoltage	▶ Check wiring ▶ Check power supply
	• Short circuits	▶ Check wiring

UK

8.3 Two-hand control using electronic sensors/switches

Example of electronic sensors/switches:

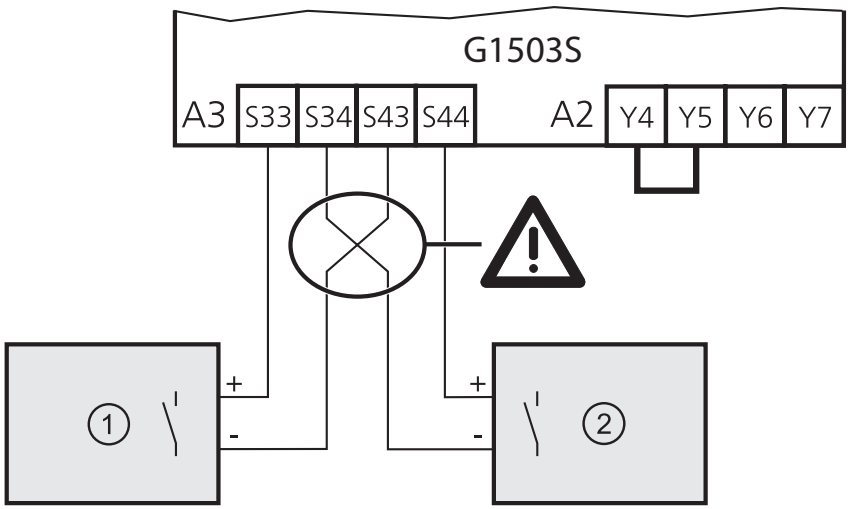
- Capacitive sensors

For product selection see www. ifm-electronic.com

This wiring meets the requirements type IIIB to EN 574. Use up to type IIIC is possible using corresponding sensors/switches with two independent switching elements, internal plausibility check and protected or screened wires.

8.3.1 Connection

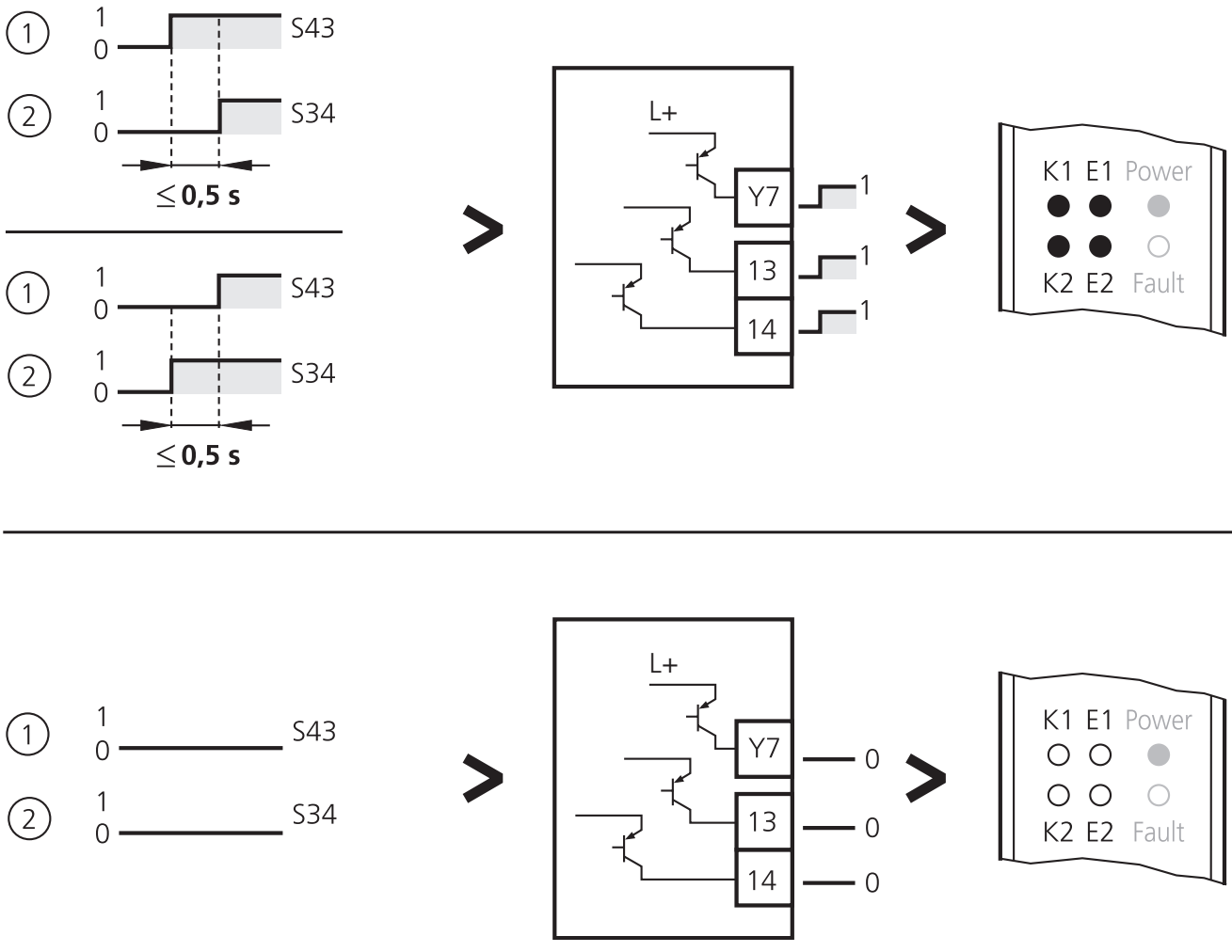
Connection of two 2-wire DC:



1: Electronic fail-safe sensor 1

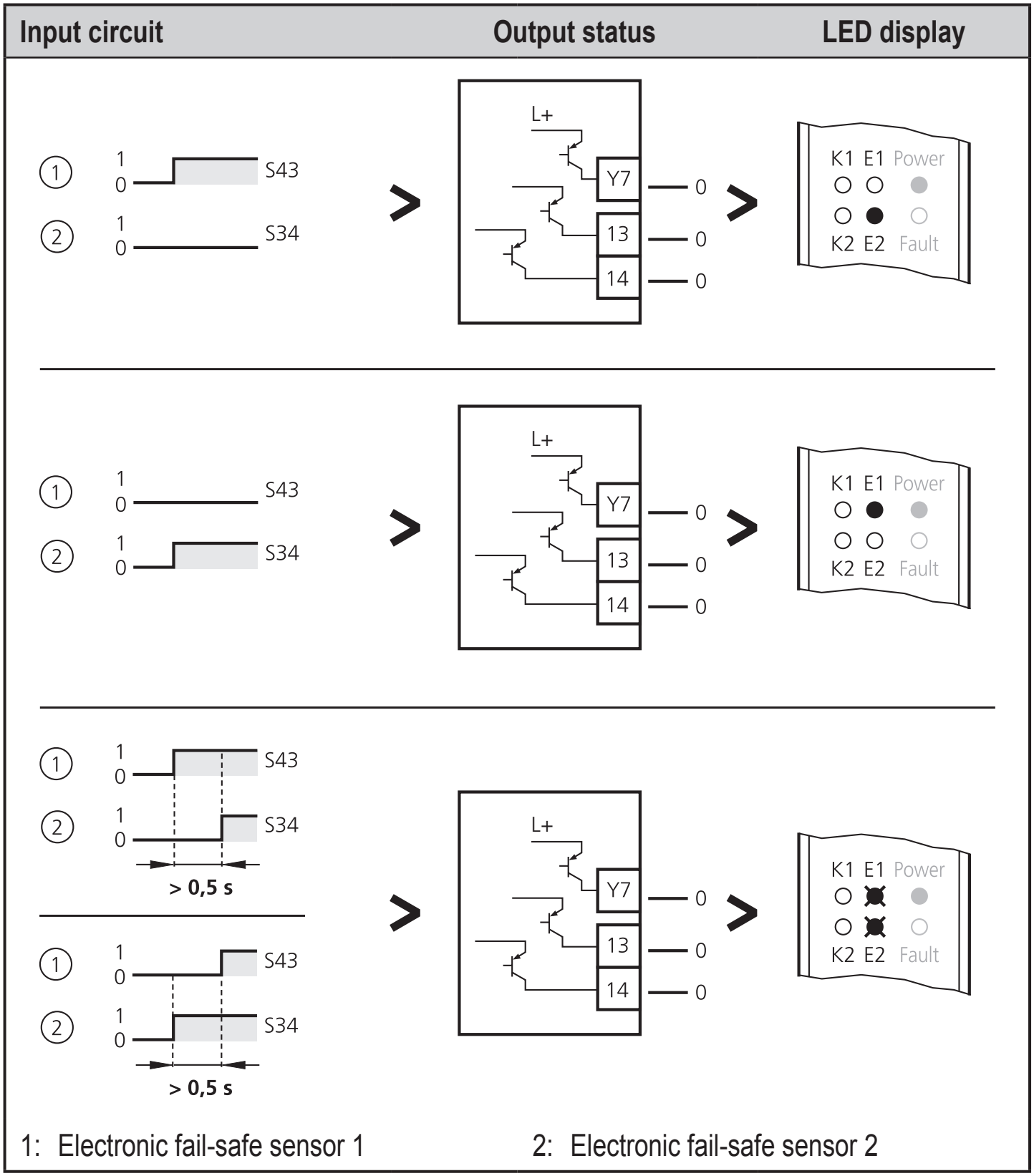
2: Electronic fail-safe sensor 2

8.3.2 Function



1: Electronic fail-safe sensor 1 2: Electronic fail-safe sensor 2

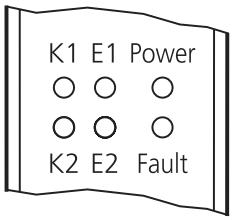
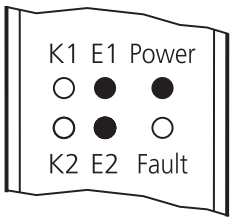
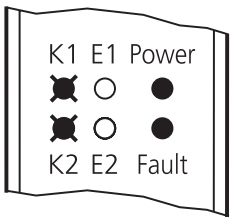
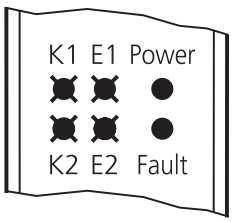
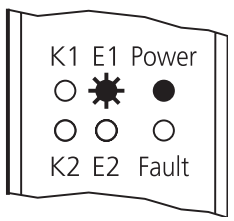
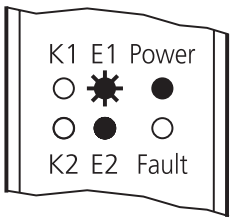
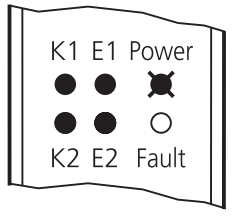
UK

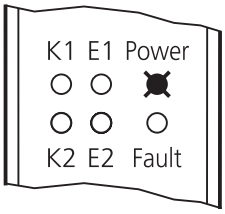
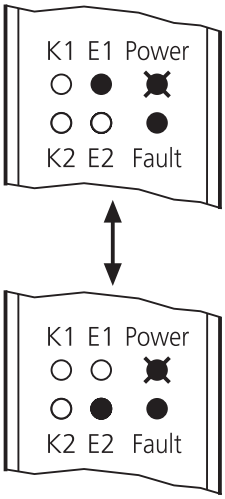
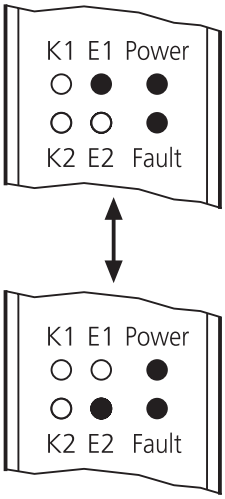
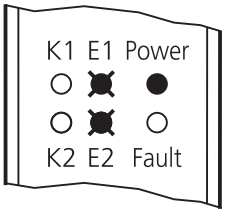


1: Electronic fail-safe sensor 1 2: Electronic fail-safe sensor 2

8.3.3 Fault diagnosis

In case of a fault switch the safety relay off and on again.

LED display	Cause of the fault	Troubleshooting
	• No voltage supply • Overvoltage • Connection A1/A3 or A1/A2 reversed	▶ Check wiring ▶ Check power supply
	• Wire break • Feedback contacts open • Time-dependent contacts	▶ Check wiring ▶ Switch the safety relay off and on again
	• When voltage is applied: feedback contacts open	▶ Check output circuit ▶ Check feedback contacts ▶ Exchange external contactor
	• Wiring fault • Missing link Y4/Y5 • Short circuit • Inputs S34 and S43 activated when voltage is applied	▶ Check wiring ▶ Deactivate inputs and RESET or voltage failure
	• Connections A3/A2 exchanged	▶ Check wiring
	• Missing link Y4/Y5	▶ Check wiring
	• Overvoltage • Undervoltage	▶ Check wiring ▶ Check power supply

LED display	Cause of the fault	Troubleshooting
	• Overvoltage • Undervoltage	▶ Check wiring ▶ Check power supply
	• Undervoltage	▶ Check wiring ▶ Check power supply
	• Short circuits	▶ Check wiring
	• Inputs S34 and S43 not activated within 0.5 s (→ 8.3.2) • Feedback contact error • Short circuit S34/S44	▶ Check wiring ▶ Deactivate inputs and activate them again

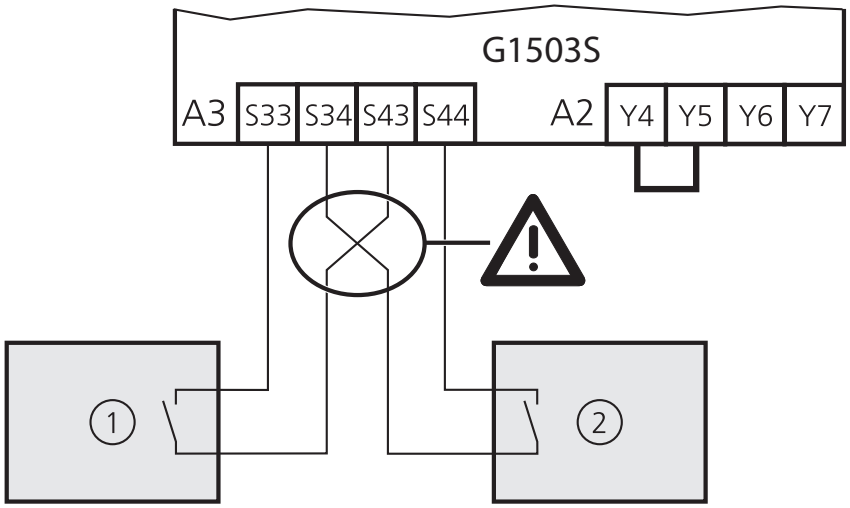
8.4 Two-hand control using mechanical switches with simultaneity monitoring

Two-hand control with mechanical switches / safety relay for mechanical switches or 2-channel fail-safe sensors/switches with contact output with simultaneity monitoring.

The contacts of the mechanical switches must allow a minimum current of 6 mA.

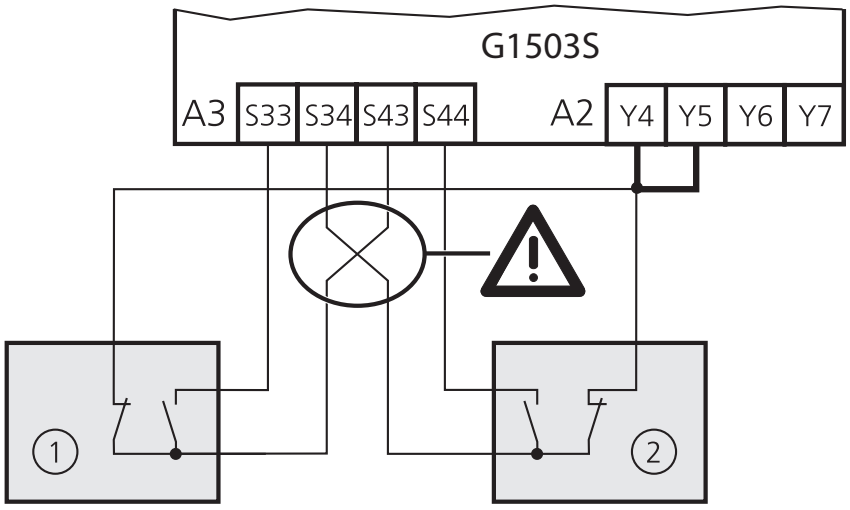
8.4.1 Connection

Connection of two mechanical fail-safe switches
This wiring (with only one normally open contact per sensor/switch) meets the requirements of type IIIB to EN 574.
Use up to type IIIC is possible using corresponding sensors/switches approved to EN 60947-5-1 annex K and protected or screened wires.



1: Mechanical fail-safe switch 1
2: Mechanical fail-safe switch 2

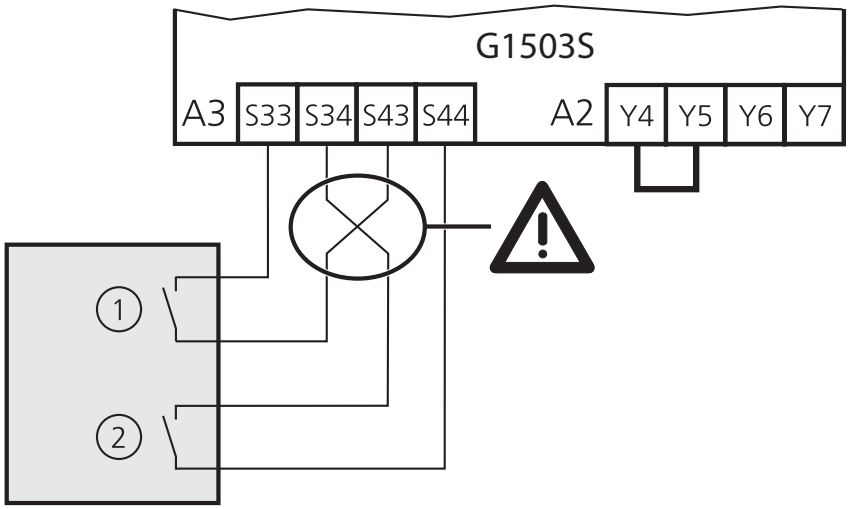
Connection of mechanical switches according to type IIIC to EN 574



1: Mechanical switch 1 (no positively driven contacts)

2: Mechanical switch 2 (no positively driven contacts)

Connection of a 2-channel fail-safe sensor/switch
e.g. "electro-sensitive protective equipment" (ESPE) to EN 61496-1

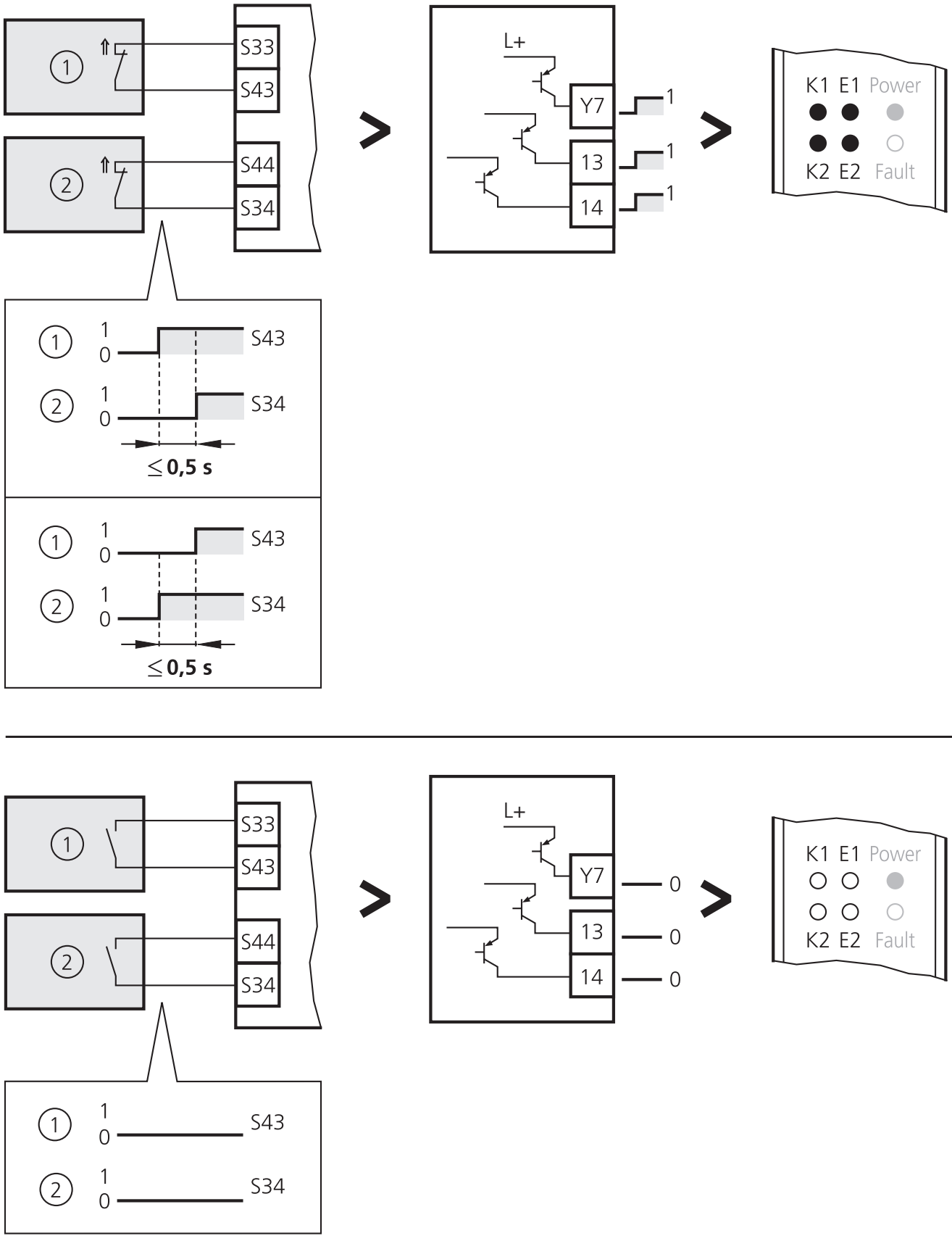


1: Contact 1 of the ESPE

2: Contact 2 of the ESPE

8.4.2 Function

Input circuit	Output status	LED display



⇑ : N.O. contact activated

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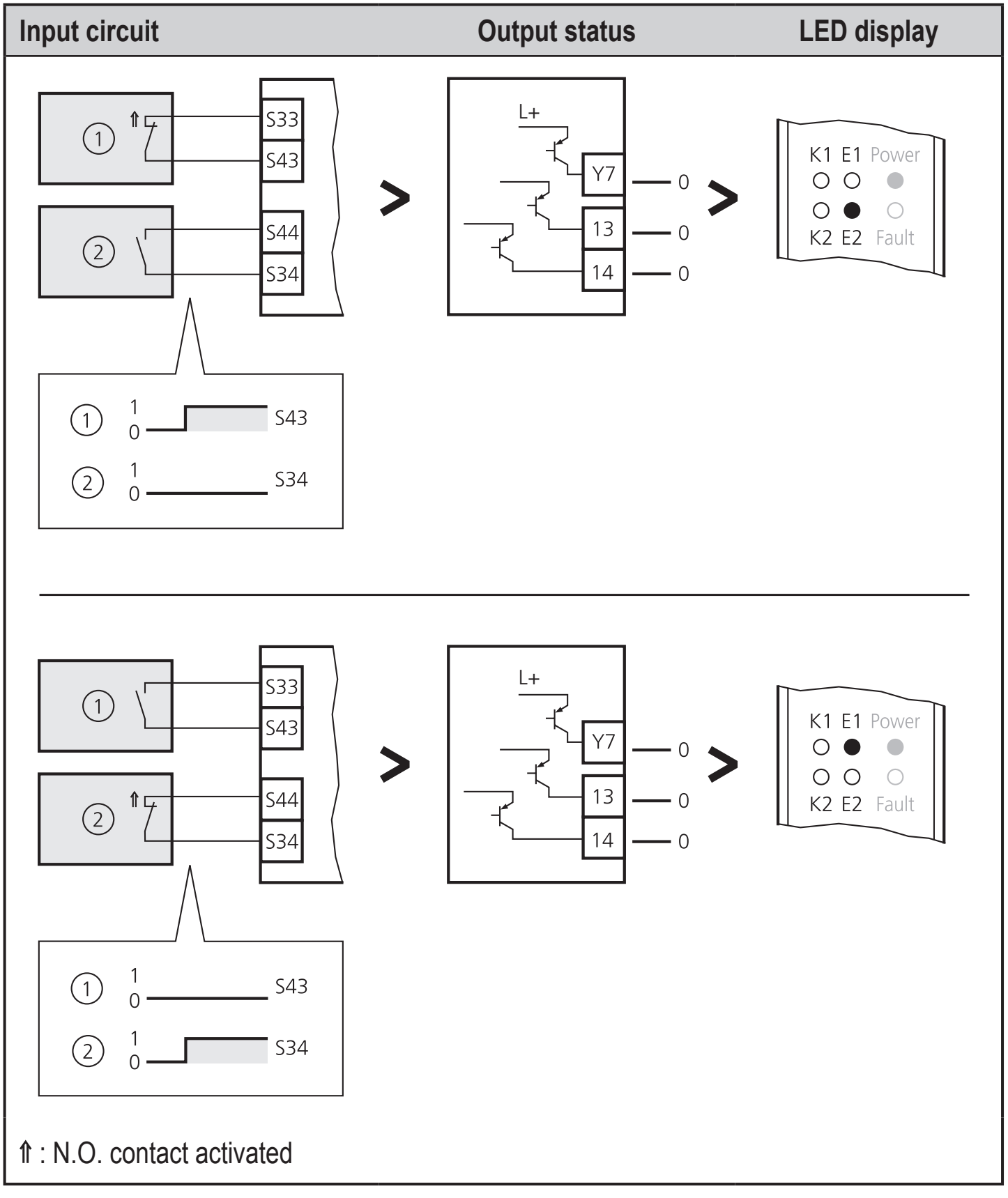
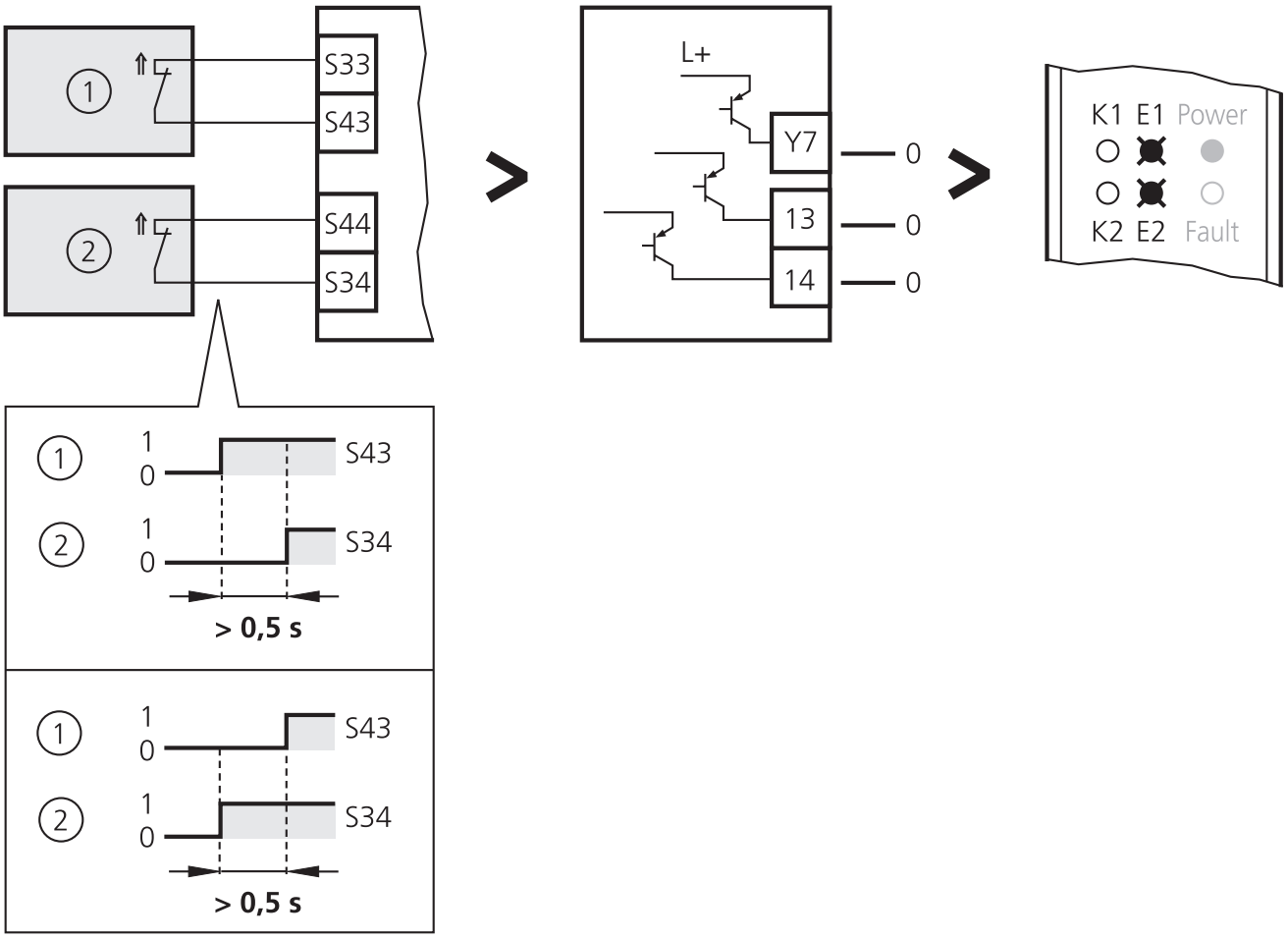


⇑ : N.O. contact activated

Input circuit	Output status	LED display

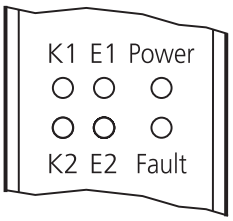
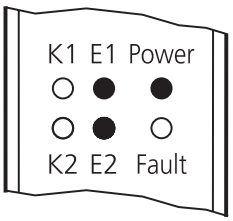
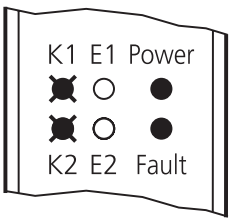
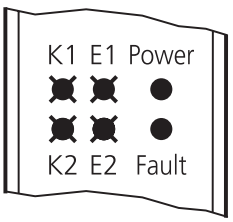
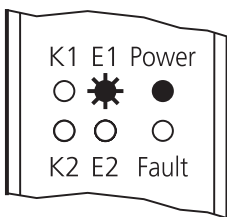
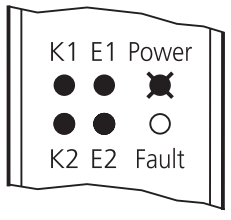
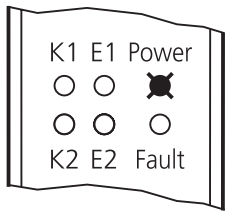


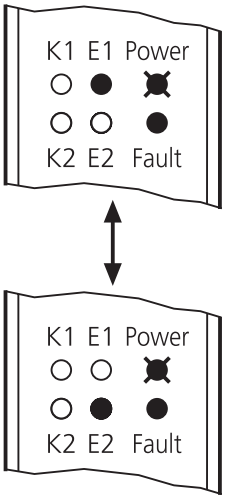
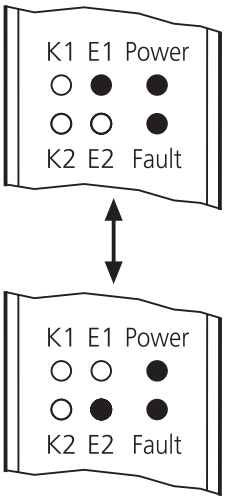
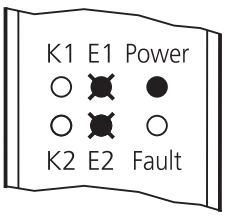
⇑ : N.O. contact activated

UK

8.4.3 Fault diagnosis

In case of a fault switch the safety relay off and on again!

LED display	Cause of the fault	Troubleshooting
	• No voltage supply • Overvoltage • Connection A1/A3 or A1/A2 reversed	▶ Check wiring ▶ Check power supply
	• Wire break • Feedback contacts open • Time-dependent contacts	▶ Check wiring ▶ Switch the safety relay off and on again
	• When voltage is applied: feedback contacts open	▶ Check output circuit ▶ Check feedback contacts ▶ Exchange external contactor
	• Wiring fault • Missing link Y4/Y5 • Short circuit • Contacts closed when voltage is applied	▶ Check wiring ▶ Open contacts and RESET or voltage failure
	• Connection A2/A3 exchanged	▶ Check wiring
	• Overvoltage • Undervoltage	▶ Check wiring ▶ Check power supply
	• Overvoltage • Undervoltage	▶ Check wiring ▶ Check power supply

LED display	Cause of the fault	Troubleshooting
	• Undervoltage	▶ Check wiring ▶ Check power supply
	• Short circuits	▶ Check wiring
	• Inputs S34 and S43 not activated within 0.5 s (→ 8.4.2) • Feedback contact error • Short circuit S34/S44	▶ Check wiring ▶ Deactivate inputs and activate them again

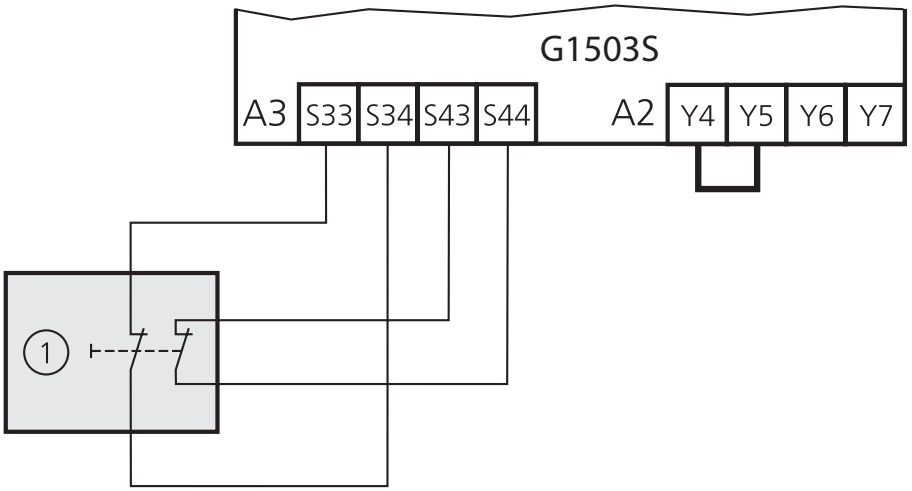
8.5 Safety relay for e-stop, for 2-channel fail-safe sensors/ switches with contact output without simultaneity monitoring or for mechanical switches

The 2-channel fail-safe sensors/switches are for example "electro-sensitive protective equipment" (ESPE) to EN 61496-1.

The contacts of the sensors/switches must allow a minimum current of 6 mA.

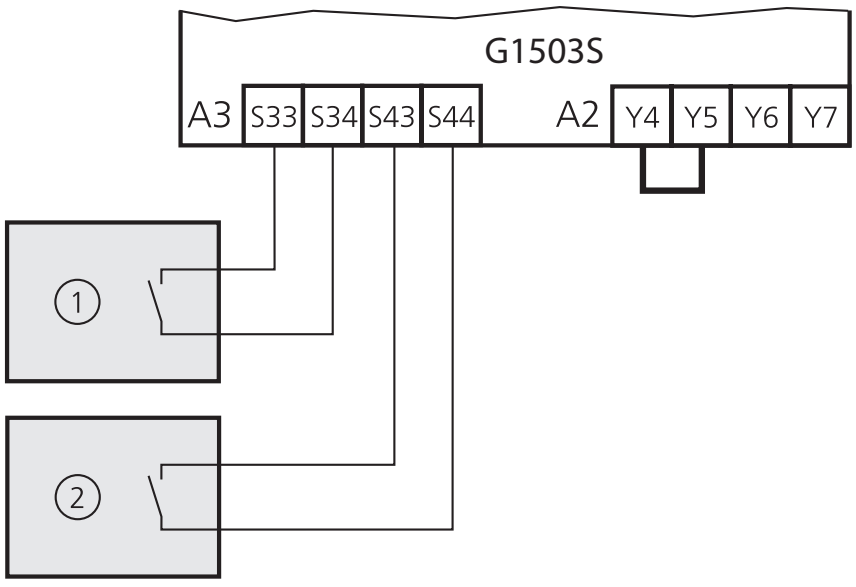
8.5.1 Connection

Connection e-stop / 2-channel fail-safe sensors/switches:



1: Fail-safe sensor/switch

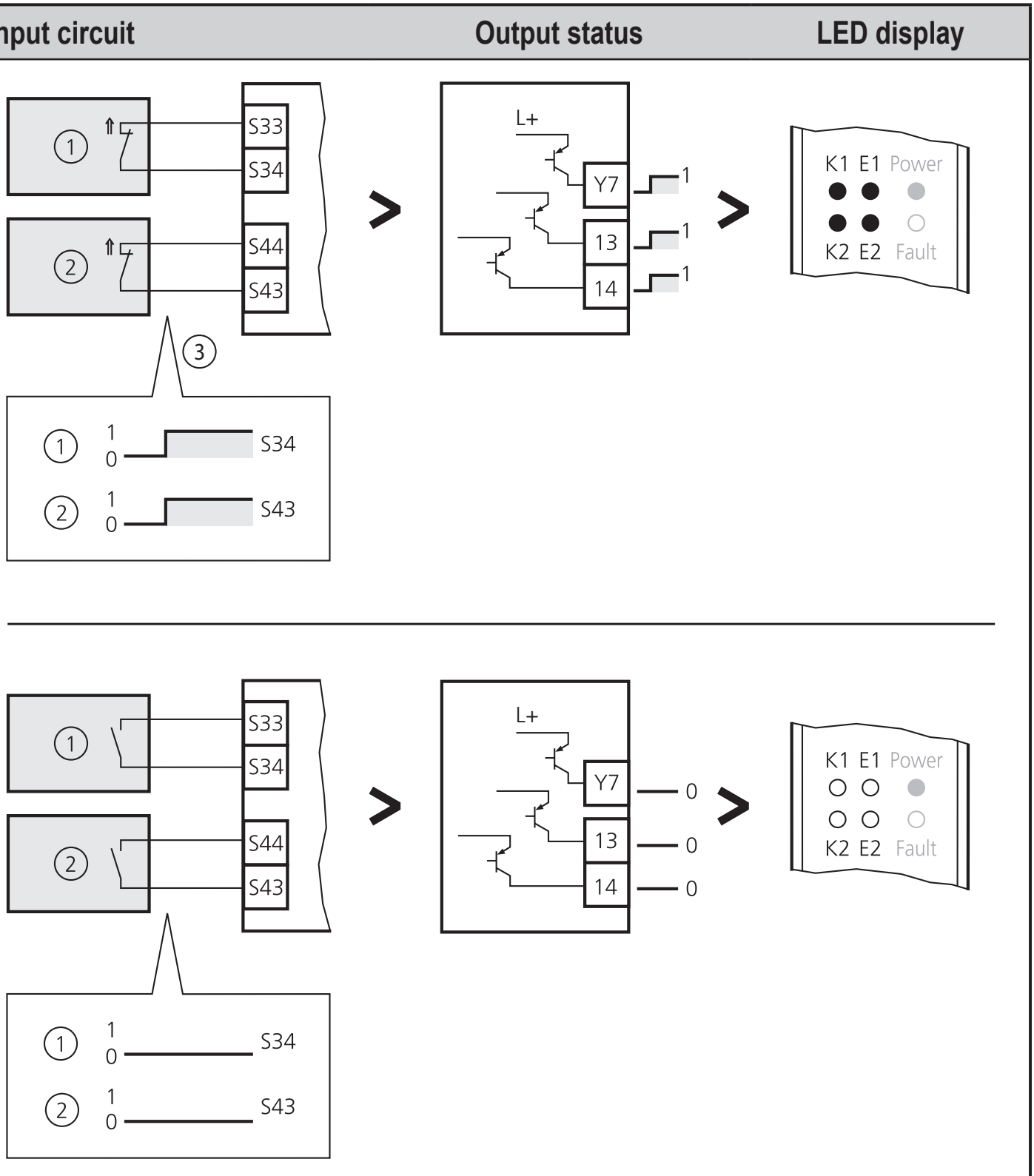
Connection of two mechanical switches:



1: Mechanical switch 1

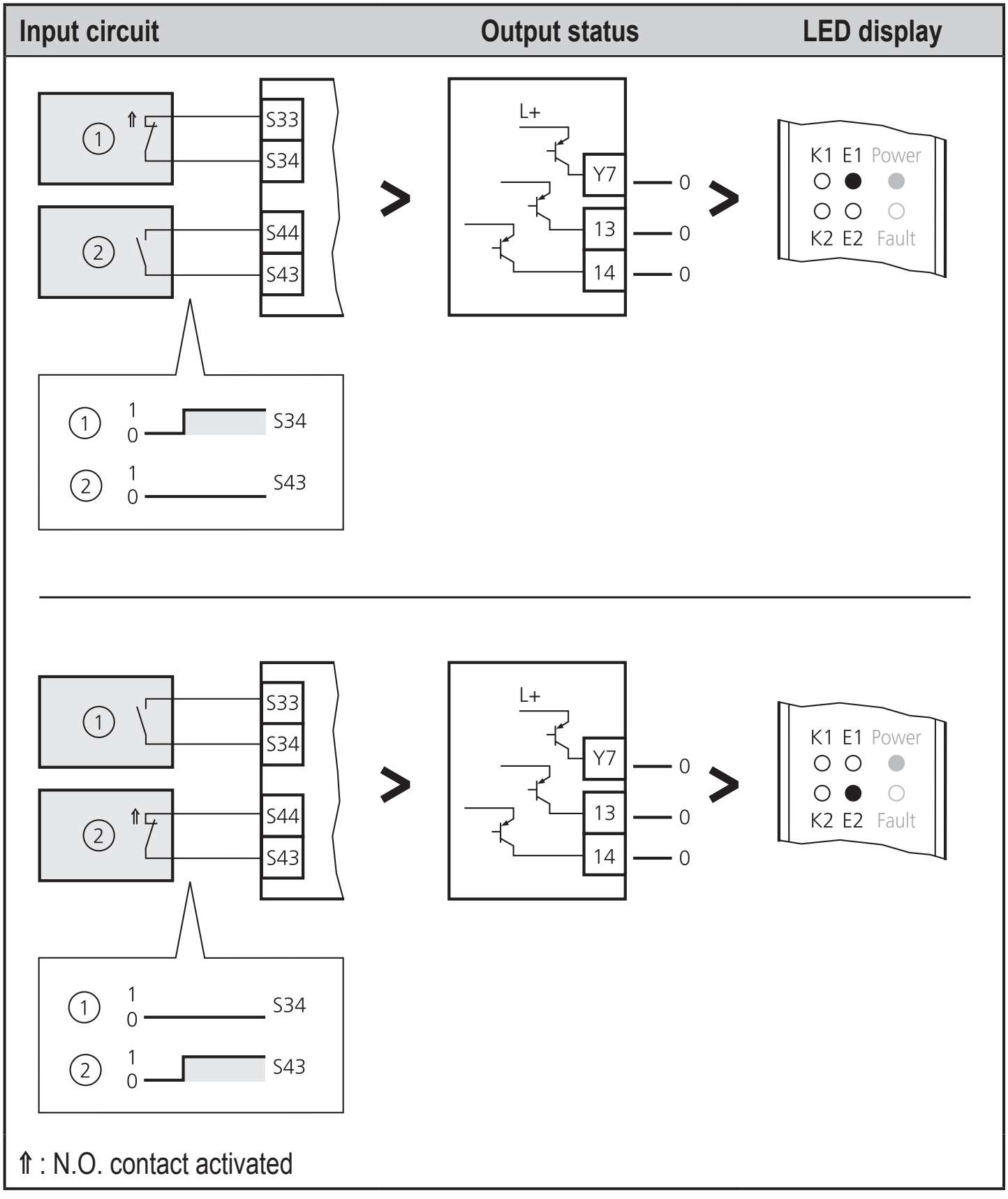
2: Mechanical switch 2

8.5.2 Function



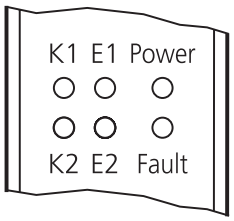
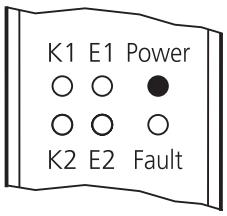
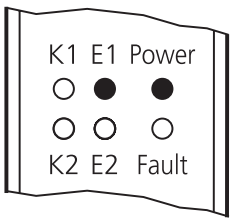
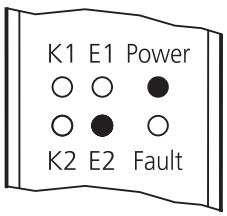
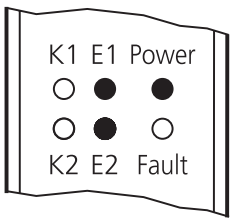
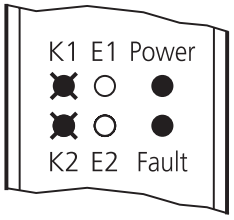
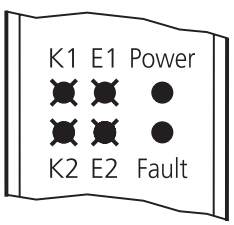
1: Fail-safe sensor/switch 1
2: Fail-safe sensor/switch 2
3: Order and time difference insignificant (indefinite simultaneity)
⇑ : N.O. contact activated

UK

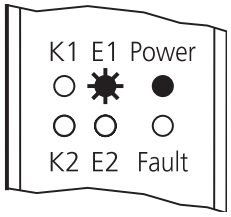
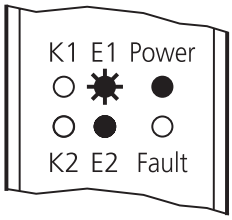
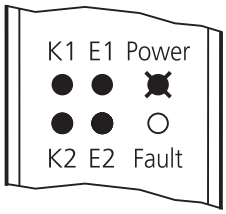
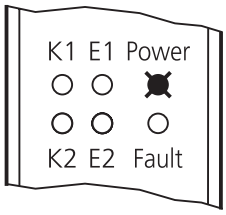
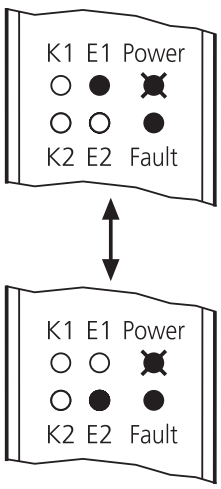
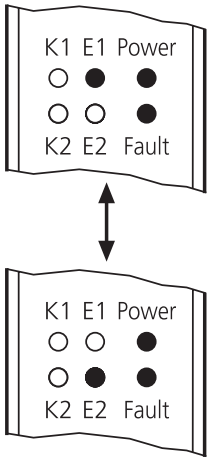

Input circuit
Output status
LED display
S33
S34
S44
S43
L+
Y7
13
14
0
0
0
K1 E1 Power
K2 E2 Fault
1
0
S34
S43
⇑ : N.O. contact activated

8.5.3 Fault diagnosis

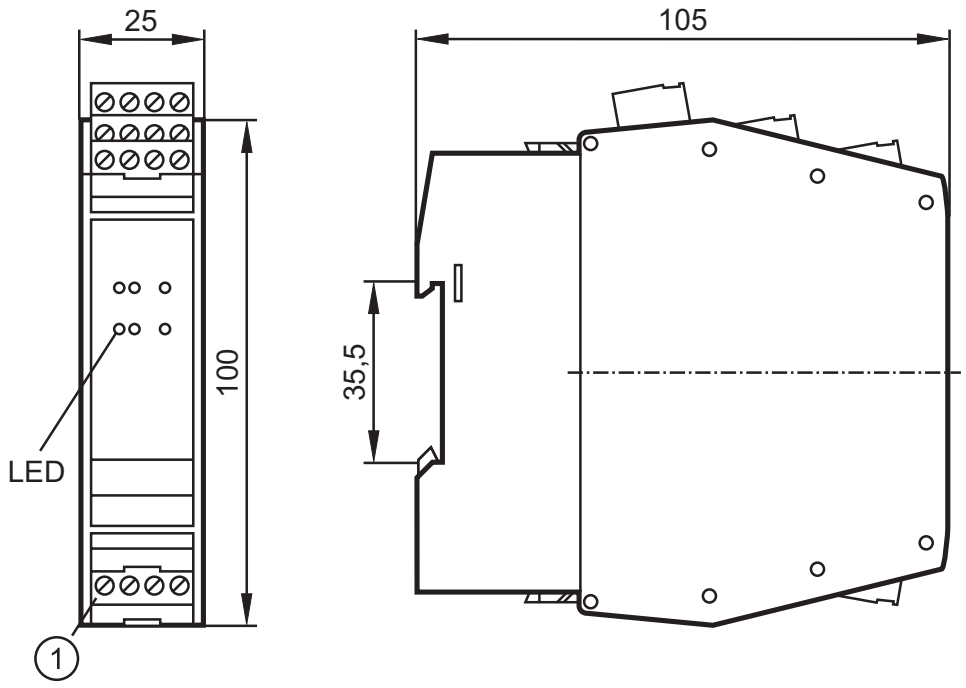
In case of a fault switch the safety relay off and on again!

LED display	Cause of the fault	Troubleshooting
	• No voltage supply • Overvoltage	▶ Check wiring ▶ Check power supply
	• Short circuit • Wire break	▶ Check wiring
	• Short circuit • Wire break	▶ Check wiring
	• Short circuit • Wire break	▶ Check wiring
	• Feedback contacts open • Wire break	▶ Check wiring
	• When voltage is applied: feedback contacts open	▶ Check output circuit ▶ Check feedback contacts ▶ Exchange external contactor
	• Wiring fault • Missing link Y4/Y5 • Short circuit	▶ Check wiring

UK

LED display	Cause of the fault	Troubleshooting
	• Connection A2/A3 exchanged	▶ Check wiring
	• Missing link Y4/Y5	▶ Check wiring
	• Overvoltage • Undervoltage	▶ Check wiring ▶ Check power supply
	• Overvoltage • Undervoltage	▶ Check wiring ▶ Check power supply
	• Undervoltage	▶ Check wiring ▶ Check power supply
	• Short circuits	▶ Check wiring

9 Scale drawing



1: screw terminal (supplied)

10 Technical data

G1503S

Safety relay with semiconductor outputs

Terminal block Phoenix Contact MSTBO

Conforms to the requirements of:
EN ISO 13849-1: 2008 category 4 PL e, SIL 3 (IEC 61508), type IIIC (EN 574)

Electrical design	semiconductor (2 OSSD)
Output function	2 safe short-circuit proof semiconductor outputs (positive switching), 1 signal output (positive switching)
Operating voltage	24 V DC (19.2...30) incl. 5 % residual ripple
Output current per safe semiconductor output (13, 14)	100 mA
Min. load current of the feedback contacts	10 mA
Short-circuit protection / overload protection semiconductor outputs (13, 14)	short-circuit proof and overload protected (overvoltage: max. 60 V DC duration, 120 V @ 200ms)

Current consumption	< 500 mA				
Function display	voltage (green), error (1 x red), output status (2 x yellow), input (2 x yellow)				
Power-on delay time	< 6 s				
Duration of switch-off test pulses	≤ 500 µs				
Voltage drop (per OSSD)	≤ 2.5 V @ 100 mA				
Response time [ms]	acc. to input circuit → chapter				
	8.1	8.2	8.3	8.4	8.5
Release	40 ms	160 ms	40 ms	110 ms	110 ms
Safety requirement	30 ms	100 ms	30 ms	30 ms	30 ms
Ambient temperature	-25...55 °C				
Protection rating	IP 20				
Housing materials	PA				
Input characteristics (S34, S43)	"1": > 11 V, 6 mA "0": < 5 V, < 500 µA				
Output characteristics	S33 push-pull short-circuit proof "0": I_{sink} ~ 30 mA "1": I_{source} ≥ 50 mA, U > 18 V S44 "0": I_R ≤ 300 µA "1": I_{source} ≥ 50 mA, U > 18 V Y7 "0": I_R ≤ 300 µA "1": I_{source} ≥ 11 V @ 30 mA, ≥ 15 V @ 15 mA				
Mission Time (TM)	175 200 h				
Safety-related reliability PFH	2.91 x 10^{-10} / h				
$MTTF_d$	232 years				
DC / CCF / Cat.:	> 99 % / 80 % / 4				
Comments	Additional information in the context with the cULus approval (UL 508): • Maximum ambient temperature 55 °C • The safety functions are not evaluated by UL. The approval is accomplished according to UL 508, general use applications. • Use 60/75 °C copper conductors only • For use in pollution degree 2 environment • Same polarity related to output contacts				

11 Tests/approvals

The safety relay G1503S was tested and certified by TÜV-Nord. The safety relay was developed and tested in accordance with, for example, the following directives and standards:

- 2006/42/EC Machinery Directive
- 2004/108/EC EMC Directive
- 2006/95/EC Low Voltage Directive
- DIN EN 50178 (1998) Electronic equipment for use in power installations
- DIN EN ISO 13849-1 (2008): Safety of machines - safety-related parts of control systems
- DIN EN 60204-1: (2007) (where applicable) Electrical equipment of machines
- DIN EN 61496-1 (2009): Non-contact protective equipment - General requirements and tests
- DIN EN 574 (1996 + A1/2008): Safety of Machinery - Two-Hand Control Devices - Functional Aspects – Principles for Design
- IEC 61508: (2000-2003): Functional safety of electrical/electronic/ programmable electronic safety-related systems
- DIN EN 62061 (2005): Safety of Machinery - Functional safety of electrical, electronic and programmable safety-related control systems
- UL 508

12 Terms and abbreviations

ESPE		Electro-Sensitive Protective Equipment
Cat.	Category	Classification of the safety-related parts of a controller as regards their resistance to failures.
CCF	Common Cause Failure	
DC	Diagnostic Coverage	
MTTF	Mean Time to Failure	
$MTTF_d$	Mean Time To Dangerous Failure	
OSSD	Output Signal Switching Device	Output signal switch element, static safety-related output.
PFH (PFH_D)	Probability of (dangerous) Failure per Hour	
PL	Performance Level	PL to EN ISO 13849-1
SIL	Safety Integrity Level	SIL 1-4 to IEC 61508.
PLC		Programmable Logic Controller

Technical data and further information at

www.ifm.com → Select your country → Data sheet direct: